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RESEARCH

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FEASIBILITY ANALYSIS OF DEPLOYING WIRELESS LOCAL AREA NETWORKS (WLANS) ONBOARD SUBMARINES AND SURFACE SHIPS

Associate Professor Xiaoping Yun, Department of Electrical and Computer Engineering
Professor Ted Lewis, Department of Computer Science
LT Mark Matthews, United States Navy
LT Mark Roemhildt, United States Navy
LT Kurt Rothenhaus, United States Navy
LT Hanceri Sayat, Turkish Army

Introduction

Since ships have limited personnel assets, it is important to increase the productivity of every crewmember aboard. The NAVSEA New Attack Submarine (NSSN) program initially identified two areas, damage control (DC) communications and watchstander logs, for productivity improvement by deploying wireless local area networks (WLANs) onboard submarines. Accurate, timely communications between the casualty scene, different stations around the ship, and Damage Control Central (DCC) have always been of the utmost importance when combating shipboard casualties. Current damage control communications practices onboard submarines rely on a slow, error prone process involving sound powered telephone talkers and a grease pencil annotated white board. The transcription of the status information to the white board is limited to the rate and accuracy of a single person receiving and writing the voice communications and is only available to those personnel in view of the white board. There is a great need to improve DC communications. The current practice of watchstander log taking has similar needs for improvement. Logs on today's submarines are taken on paper forms, collected daily, and stapled with other watchstander logs in a large bundle. This bundle is reviewed sequentially by responsible supervisors and filed in cabinets. It is usually never looked at again. The biggest problem of this procedure is that it discourages trend analysis. If a trend analysis is to be performed, data must be either hand plotted or entered into a computer.

The productivity in these and other areas can be significantly improved by deploying wireless networks and mobile computing devices. In the damage control case, handheld computers connected to a wireless network could be used around the ship for the crew members at the casualty scene to make their report directly and electronically to DCC. The information would be displayed at DCC and elsewhere for situation awareness. Voice communications would still be available but could now be reserved for the most time critical messages. In the log-taking scenario, log data could be entered into a handheld computer and then wirelessly transmitted to a database server. This database would allow different supervisors to review the logs at any time in parallel, serve as an efficient archiving source, and most importantly,

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FEATURED PROJECT

WIRELESS NETWORKS ONBOARD SUBMARINES, *continued from page 1*

allow automatic trend analysis tools to be developed to provide timely feedback to crew members.

The NSSN program has been sponsoring the Submarine Wireless LAN (SWLAN) project for the past three years to study the feasibility of deploying WLANs onboard submarines. The scope of the project has been broadened to include other submarine applications including supply inventory, PMS as well as applications onboard surface ships. This article briefly describes approaches, issues, and results of the SWLAN project.

Objectives and Approaches

The ultimate objective of the SWLAN project is to deploy wireless local area networks (WLAN) onboard Virginia Class Submarines in support of the Non-Tactical Data Processing Subsystem (NTDPS). It is envisioned that a wireless local area network will be installed and tied to the ship's NTDPS wired network. A sufficient number of Access Points (APs) will be utilized to cover every corner of the ship. A crew member with a handheld computer will be able to wirelessly access the network anywhere within the ship. The handheld computer will be equipped with a PCMCIA card that communicates with APs at the 2.4 GHz frequency. Application software with a web browser interface will be developed for handheld computers that allows crew members to submit DC data and watchstander log data, view technical manuals, and order repair parts without leaving the repair scene.

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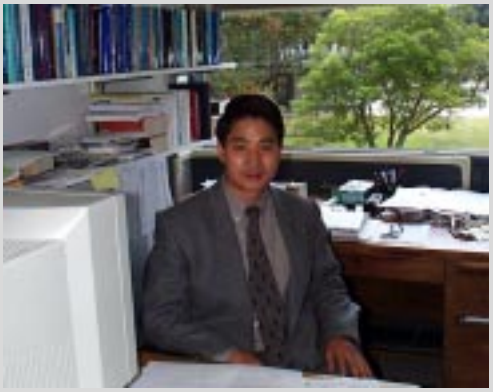
About the INVESTIGATORS



Xiaoping Yun

Xiaoping Yun is an Associate Professor in the Department of Electrical and Computer Engineering. He received his B.S. from Northeastern University in China followed by an M.S. and D.Sc. in Systems Science and Mathematics from Washington University in St. Louis. He worked as an Assistant Professor at the University of Pennsylvania before joining the Naval Postgraduate School in 1994. His teaching and research interests are in the areas of robotics, control systems, navigation systems, and wireless communications. .

Dr. Yun is a senior member of the IEEE. He is the General Co-Chair of 1999 IEEE International Symposium on Computational Intelligence in Robotics and Automation to be held in Monterey, CA, in November 1999. He serves on many professional society committees including IEEE Technical Activities Board (TAB) Award and Recognition Committee, IEEE Robotics and Automation Society Conference Board, and National Science Foundation Robotics Program Review Panel. He has published over 90 technical papers.

Ted Lewis is a Professor in the Department of Computer Science. Prior to joining the faculty of NPS, he was a professor of Computer Science at Oregon State University. He obtained his Ph.D. in Computer Science from Washington State University. He has been on the faculty of four major universities spanning a 30-year academic career. His teaching and research interests are in the areas of legacy systems re-architecting using modern 3-tier software, application development of large projects, the Internet, quantitative modeling of business processes, and the application of Lanchester theory to marketing.

Ted Lewis

Dr. Lewis is a prolific writer, having published over 25 books, and more than 100 technical papers. His most recent textbook is *Distributed and Parallel Computing*, with H. El-Rewini. His most recent popular book is *The Friction Free Economy.* He is a contributor or serves on editorial boards of several computing journals. Dr. Lewis is active as a consultant to both the computer industry and the Department of Defense.

WIRELESS NETWORKS ONBOARD SUBMARINES, *continued from page 2*

Research Issues

The above approach of using wireless technology has the potential for significant improvements in shipboard operations. Nevertheless, there are many issues that must be studied. The SWLAN project team focused its efforts in the following three areas:

1. Investigate the feasibility of deploying commercial-off-the-shelf (COTS) wireless networks in mostly metallic shipboard environments.
2. Evaluate COTS handheld computers and wearable computers for shipboard use in connection with wireless networks.
3. Develop prototype software for damage control, watchstander log taking, and other applications.

Commercial WLAN products utilize the 900 MHz or 2.4 GHz Industrial, Science, and Medical (ISM) frequency bands. They use Frequency Hopping Spread Spectrum (FH/SS) or Direct Sequence Spread Spectrum (DS/SS) modulation. One of the major concerns in deploying WLANs in shipboard environments is multi-path-fading effects of radio frequency (RF) communications. The feasibility analysis is conducted by means of laboratory testing and shipboard testing, and by investigating issues of transmission range, data throughput, roaming between access points, IEEE 802.11 compliance, electromagnetic interference (EMI) and electromagnetic compatibility (EMC), Hazards of Electromagnetic Radiation on Ordnance (HERO) compliance, network security, and power consumption.

Handheld computers and wearable computers are available in many different forms. Evaluation criteria include form factor, operating system, input method (handwriting, keyboard, mini on-screen keyboard, voice), comfort, ruggedness, and battery life. A market survey was conducted. Selected products including a Mitsubishi Amity pen-based handheld computer, a Xybernaut wearable computer, a ViA II wearable computer, and a Casio Casiopeia were acquired for further evaluation. Both Window 95/98 and Window CE based machines were considered, but they must have at least one PCMCIA slot to be connected to the WLAN through a PCMCIA card.

Prototype software applications were written in Java with a web browser type of interface. Java was chosen because of the distributed nature of applet architecture, and the availability of Java Virtual Machine (usually bundled with a browser) for a wide range of processors. Applets allow users to run programs from a remote server without requiring any client side setup. For damage control and other applications, the prototype control station was written in an applet and ran on a laptop or desktop computer. The reporting agent on the client side was written in both an applet and a servlet and typically ran on a handheld computer or a wearable computer. A servlet version was also developed to allow it to be run on smaller Window CE devices that operate a light web browser and do not support Java applets.

As an example, Figure 1 shows the interface of the damage control console applet. This applet uses the Java.AWT API to support the graphical user interface and the Java.SQL API to interface with an Access database. On the top of the graphical interface is a VRML image of the submarine. The VRML image communicates with the applet to visually display casualty locations. The applet accesses the database using standard SQL commands that are tied to events in the graphical interface.

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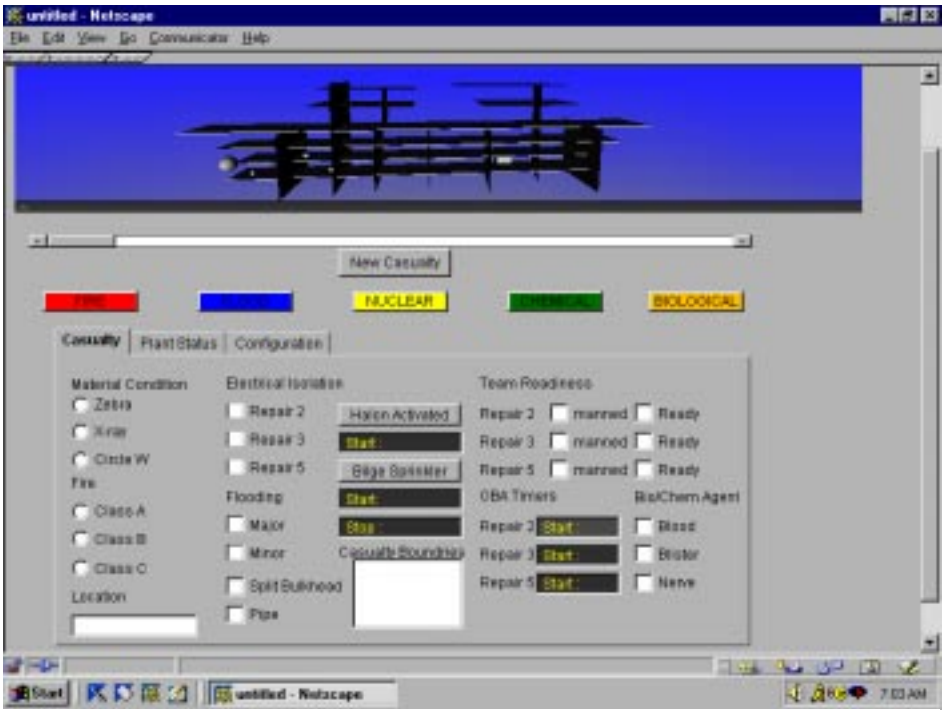

Figure 1. Damage Control Console

FEATURED PROJECT

ORGANIZATIONAL FACTORS IN AVIATION ACCIDENTS

Professor Anthony Ciavarelli, School of Aviation Safety
LtCol Robert Figlock, USMC, School of Aviation Safety
Associate Professor Kishore Sengupta, Information Systems Academic Group

Introduction

The aircraft mishap rate has declined substantially over the past fifty years of Naval Aviation. The U.S. Navy aircraft mishap rate, just twenty years ago, stood at about ten aircraft losses for every 100,000 flight-hours. The loss rate has dropped steadily over the years to its present level of about two aircraft per 100,000 flight hours. While the accident rate has declined appreciably, the number of aircraft losses due to aircrew factors, or human error, has stayed relatively constant. About 60% of the U.S. Navy and U.S. Marine Corps "Class A" aircraft mishaps are considered to be caused by aircrew errors. Class "A" mishaps are those resulting in death, permanent disability, or involving aircraft damage in excess of $1million.

Much attention has been paid over the past few years to understanding human error in complex systems, including issues related to faulty human engineering of aircraft cockpits, instances of poor pilot judgment, and more recently, errors regarding breakdowns of crew communication and coordination. Relatively little had been accomplished concerning the potential contribution of organizational factors on aircrew performance and safety.

Background

Shortly after taking command of the Pacific Fleet Naval Air Force in 1996, VADM Brent M. Bennitt set an ambitious goal—to cut our 1996 human factor-caused Class "A" flight mishap rate in half by the year 2000. At VADM Bennitt's direction, the Air Board established a Human Factors Quality Management Board (QMB). The QMB was chartered to analyze and recommend improvements to processes, pro-

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About the INVESTIGATORS

Anthony Ciavarelli

Anthony P. Ciavarelli is a Professor of Psychology in the School of Aviation Safety and is currently the Associate Provost for Instruction. He received his B.A. and M.A. from the California State University at Los Angeles and his Doctorate of Education from the University of Southern California. He held both technical and management positions in the Defense Industry at the time he was completing his graduate studies. Prior to joining NPS, Dr. Ciavarelli served as a technical consultant to industry and government in the areas of aircrew training, safety and human factor design. He has served as a senior technical advisor to the U.S. Navy, and other Federal agencies (Federal Aviation Agency/Department of Energy) or their contractors in the areas of Safety and Human Factors. He joined the faculty of the Naval Postgraduate School in 1989.

As an educator, Dr. Ciavarelli's focus is on the design, development, and evaluation of complex human-machine systems. He has contributed to National and International working groups for air safety, including the Flight Safety Foundation ICARUS Group, the Federal Aviation Agency Pilot Training Working Group, and ICAO Human Factors Committee. He is past Editor-in-Chief of the Training Technology Journal.

Robert Figlock

Robert Figlock is an Assistant Professor of Aviation Psychology in the School of Aviation Safety. He completed his undergraduate work at Bloomsburg University and a M.S. in Systems Management from the University of Southern California. He is currently pursuing his Doctor of

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ORGANIZATIONAL FACTORS IN AVIATION ACCIDENTS, *continued from page 4*

grams, and systems that affect human performance in aviation with the purpose of reducing the aviation mishap rate. The ultimate goal of the QMB is warfighting readiness and victory in combat. Preventing mishaps contributes to readiness by keeping people and airplanes available and by controlling safety-related hazards to mission success.

The membership of the QMB included representatives from each Type Commander, the Naval Safety Center, the Naval Postgraduate School's School of

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Investigators examine the wreckage of a downed aircraft.

About the INVESTIGATORS, *continued on page 5*

Philosophy degree.

Recently retired from the United States Marine Corps, Professor Figlock achieved the rank of Lieutenant Colonel. In 1979 he was the distinguished graduate of the Aviation Safety Officer (AS) Course at NPS. He was later assigned to NPS as an instructor in the School of Aviation Safety. After a tour as the Deputy Director, Marine Corps War College, Marine Corps University, he returned to NPS serving as the Interim Director, Associate Director, Programs Course Coordinator and Instructor in the School of Aviation Safety.

Kishore Sengupta is an Associate Professor in the Information Systems Academic Group. Dr. Sengupta received his Ph.D. in Information Systems from Case Western Reserve University in 1990. He was a Visiting Scholar at the Hong Kong University of Science and Technology in 1996-1997. Dr. Sengupta has previously worked with AT&T Network Software Center (now Lucent Technologies) and with Arthur Young International (now Ernst & Young).

Kishore Sengupta

Dr. Sengupta's research interests focus on knowledge management in virtual organizations, decision support for dynamic decision environments, and computer support for collaborative environments. Dr. Sengupta has published extensively in leading journals in Information Systems, Decision Sciences, and Management.

This study was done in conjunction with the University of California, Berkeley, and the University of California, Los Angeles. Karlene Roberts is a Professor at the Walter A. Haas School of Business at the University of California, Berkeley. Her Ph.D. is in Psychology. Dr. Roberts began her Navy research when the F-14s entered the Fleet. She and her colleagues later did a sweeping study of how the *USS Carl Vinson* operated when the *Vinson* was under the command of RADM Thomas Mercer, USN. (RADM Mercer later served as the Superintendent of the Naval Postgraduate School.) Dr. Roberts continues to do special projects for the Navy. Dr. Carolyn Libuser received her Ph.D. from UCLA. Her thesis developed the conceptual model that underlies the CSA.

THE TOTAL SHIP SYSTEMS ENGINEERING PROGRAM

As the Navy's graduate University, the Naval Postgraduate School has contributed for many years to the improvement of the combat capability of the Navy and U.S. forces, as called for in its mission. But it was only with the establishment of the Total Ship Systems Engineering (TSSE) Program in 1991 that NPS developed a capability to focus on whole-ship design and research.

The TSSE program arose out of two separate developments. The Naval Sea Systems Command (NAVSEA) recognized a need to improve the utilization of Systems Engineering methods in its work – both in the development of ship combat systems and in the integration of the entire ship – the hull, mechanical and electrical as well as the combat systems. NPS was anticipating the growing awareness in engineering academia of the need to increase the design and systems integration content in engineering programs. These two driving forces met, with the result that the NAVSEA and NPS signed a Memorandum of Agreement in 1991, establishing the TSSE program under NAVSEA sponsorship. The Agreement called for the assignment of two TSSE professors, one with major combat systems experience and the other with experience in the design of Navy ships.

TSSE *Total Ships Systems Engineering*

The objective of the program is to provide a broad based, systems engineering and design oriented curriculum focusing on the warship as a total engineering system. This, of course, requires an interdisciplinary engineering approach, including material appropriate for students in three NPS curricula: Naval/Mechanical Engineering; Combat Systems Science and Technology; and Electrical and Computer Engineering. Students from these three curricula may enter the TSSE Program.

Professor Chuck Calvano of the Department of Mechanical Engineering, a former Director of the Ship Design Group of the Navy, joined the NPS faculty in 1991 to become the ship design TSSE faculty member and to lead the program. Senior Lecturer Francis Fassnacht was the combat systems member until his retirement in 1995, when Associate Professor Bob Harney (Department of Physics) joined the faculty in that role. These two TSSE faculty members are supported by Associate Professor Fotis Papoulias, Department of Mechanical Engineering, and Associate Professor Bob Ashton and Assistant Professor John Ciezki of the Department of Electrical and Computer Engineering.

The approach taken is to treat the individual students' Masters Degree program as the knowledge foundation; TSSE adds to this foundation courses which address systems engineering principles and processes and integration processes and techniques. The program culminates in a two-quarter long, two-course design project in which the students, acting as an interdisciplinary design team, produce a conceptual design of a Navy ship (see table 1).

The students graduate with the subspecialty codes of their respective curricula, plus a formal indication that they have completed the TSSE program. Graduates may think of themselves as Combat Systems Engineers (or Mechanical Engineers, or Electrical Engineers) who also know how complex defense systems, such as Navy ships, are developed and designed. They are well-equipped for later assignment to technical positions in program offices, in systems acquisition and development organizations, and in requirements setting organizations such as OPNAV and CINC staffs. TSSE student graduates have been assigned duties such as Senior Systems Engineer for SC/DD 21, waterfront management for

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Capstone Design Project **Realistic, Team-Based Application**
TSSE Courses **Systems Engineering Principles and Processes** **Integration Processes and Techniques**
MS Degree (ME / Physics / ECE) - Foundation **Engineering, Understanding of Major Elements**

Table 1. NPS Total Ship Systems Engineering Curriculum Approach

TOTAL SHIP SYSTEMS, *contined from page 6*

construction of DDG51 Class ships and technical positions in the office of the Program Executive Officer (PEO) for Theater Surface Combatants. The program has graduated 51

Service		Curriculum	
Navy	42	Naval/Mech. Eng'g	32
Coast Guard	7	Electrical Eng'g	10
Marine Corps	1	Combat Systems	8
Civilian	1	Space Systems	1

Table 2: NPS Graduates from the Total Ship Systems Engineering Program

officers through '98, with their makeup as shown in Table 2.

The ship designs produced by student teams have, in some cases, been performed for interested Navy commands who wished to have a design alternative explored or who were searching for additional ideas for innovation. For instance, the Navy's Program Officer for the next generation of aircraft carrier, when beginning its design explorations, wished to have some idea of what would be the implications for the carrier design if all aircraft could be of the Short Takeoff/ Vertical Landing (STOVL) type. The CVX (now CVNX) Program Manager asked that the TSSE student design for 1997 be of a STOVL carrier, as shown in Figure 1, with the student design report made available to that office.

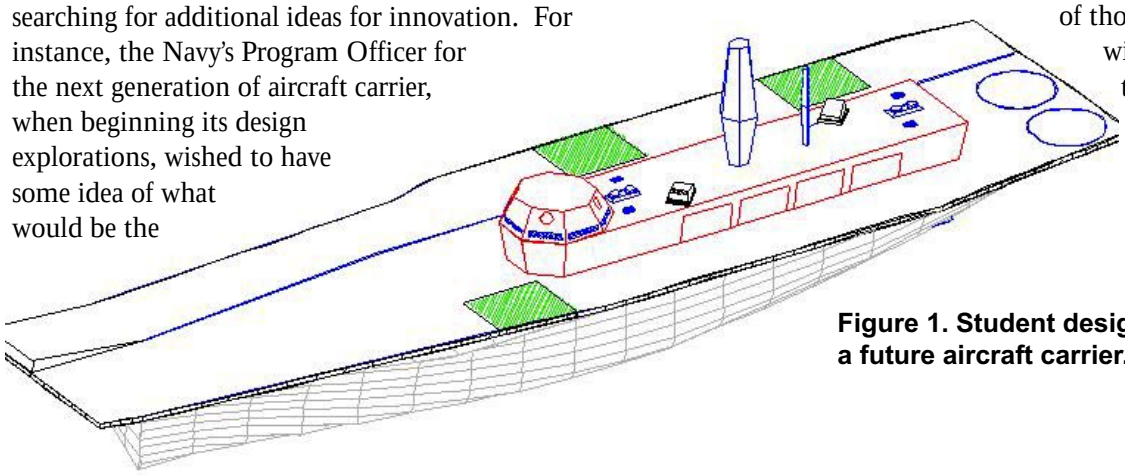

Figure 1. Student design of a future aircraft carrier.

When the Navy was contracting with industry teams to perform conceptual designs for an Arsenal Ship, the Assistant Secretary of the Navy for Research, Development and Acquisition asked that the TSSE design for 1996 be done to the same requirements documents as were being used by the industry teams. The resulting student design of an Arsenal Ship was made available to him.

The 1999 design, currently in progress, is of a DD-963 class-based conversion of a Self Defense Test Ship for use by the Port Hueneme Division (PHD) of the Naval Surface Warfare Center. PHD is the "customer" for this design and has provided the initial requirements document; the student design will be used to assist them in deciding what specific features to incorporate in the actual conversion. Students have also produced a design for the Maritime Prepositioning Ship for 2010 (Figure 2), in response to a requirements document prepared by the Center for Naval Analyses (CNA) and the U.S Marine Corps.

Members of the Navy and industry ship and combat systems design community are invited to attend the student design presentation each December. They participate in a valuable give-and-take with the student team which contributes to the education process and helps make the community aware of the role NPS can and does play in furthering systems engineering and systems design in the Navy.

Because TSSE has placed NPS squarely in the community of those who concern themselves with Navy whole-ship alternatives, architectures and design, new opportunities for on-campus research and design projects, some involving students, have arisen. Professor Calvano has undertaken a number of projects in recent years in the area of surface ship survivability and starting in FY 1999 he and Professor Harney began supporting Commander Operational Test and Evaluation Force (COMPOTEVFOR) in planning for the operational testing of the survivability features of the Navy's next generation amphibious ship, LPD 17. In addition, both are experiencing growing involvement in development of improved methods of systems engineering for defense systems.

A series of student theses to develop design tools for use in

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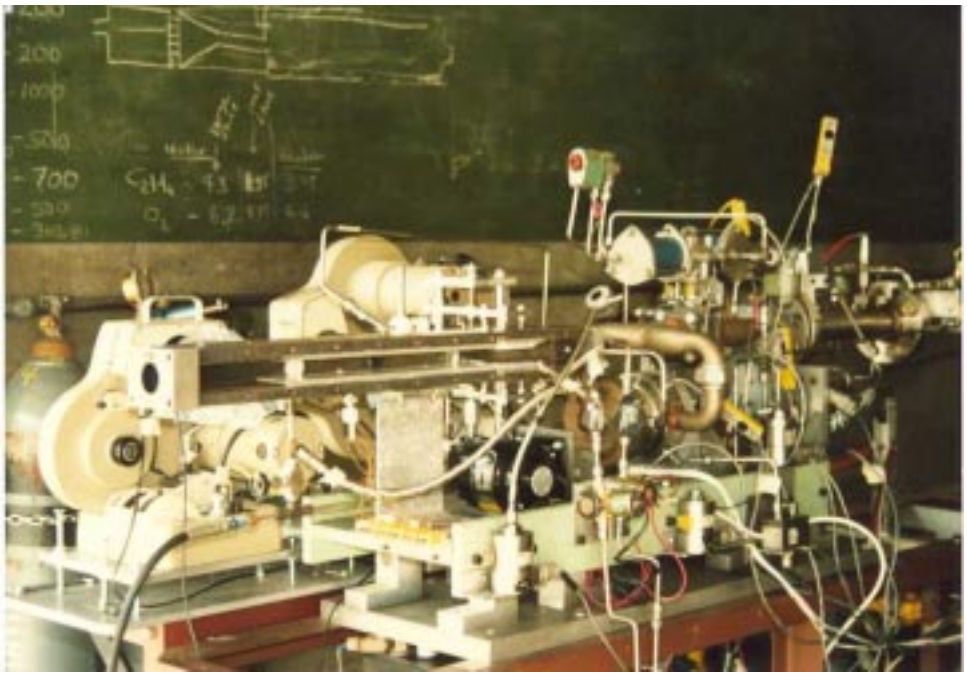
THE ROCKET PROPULSION AND COMBUSTION LABORATORY

Distinguished Professor David Netzer
Research Assistant Professor Christopher Brophy
Aerospace Technician Harry Conner
LCDR Zach Scruton, USN
LT John Robinson, USN
LT Todd Hofstedt, USN
LT Robert Johnson, USN
Department of Aeronautics and Astronautics



Optically Accessible Solid Fuel Ramjet Combustor

The Rocket Propulsion and Combustion Laboratory (RPCL) has been involved in propulsion related research at NPS since 1965. The laboratory was initially shared with the Chemistry Department and later became solely an Aeronautics and Astronautics Department laboratory in the 70s. The laboratory's focus over the past 35 years has largely been related to solid rocket motor propellants and plumes, liquid and solid fuel ramjets, liquid rocket engine development issues, and gas turbine combustors and has received support from a variety of government agencies, including the Office of Naval Research, Air Force Research Lab, and Naval Air Warfare Center-Weapons Division (NAWCWD). Over 100 students have performed thesis-related work at RPCL and it continues to support 3-4 students per year. Four masters students are currently involved with thesis work at the laboratory. The lab has also supported numerous postdoctoral research associates and visiting scientists. A new ONR-ASEE postdoctoral associate is scheduled to begin research this fall.

RPCL is part of the Aeronautics and Astronautics Department's Aeropropulsion Laboratory complex located within the Monterey Pines (formally NPS) Golf Course. It is located near the Turbopropulsion Laboratory and at the edge of the Monterey Peninsula Airport. The location was chosen due to its isolation at the time of construction and the noise generated during testing of various propulsion systems.

The laboratory consists of three test cells, two cold-flow testing areas, and a control room capable of monitoring experiments throughout the lab. Two Bauer air compressors supply a multitank high-pressure air system with up to 3000 psi air. The system provides 200 ft^3 of storage capability and can supply air at flowrates up to 8 pounds per second to each of the three test cells. The air flow rate capabilities are augmented by the use of hydrogen/oxygen vitiating heaters which allow the air temperatures to be raised to values approaching 1000° F. The combination flow rate and air temperature capabilities allow the simulation of engine inlet conditions typical of supersonic flight and is important when investigating supersonic propulsion systems such as ramjets, pulse detonation engines, and scramjets. A compressed gas bottle room delivers all combustible gases, nitrogen, and oxidizers to the test cells. Liquid and gelled fuels are pressurized by nitrogen and subsequently delivered to the selected test rig.

The hardware and infrastructure of RPCL is complemented by a wide range of diagnostic capabilities required for the investigation of various propulsion systems. Some of the diagnostic capabilities existing at the lab include a Phase Doppler Particle Analyzer (PDPA), Malvern particle analyzers, a copper-vapor laser system for Particle Image Velocimetry (PIV), high speed intensified CCD cameras, visible and infrared imaging systems, spectroradiometers, and a wide range of laser systems. PC-based, high-speed data acquisition systems are located throughout the laboratory and are used to monitor the diagnostic systems, thermocouples, and high frequency pressure transducers. A T10/100 local

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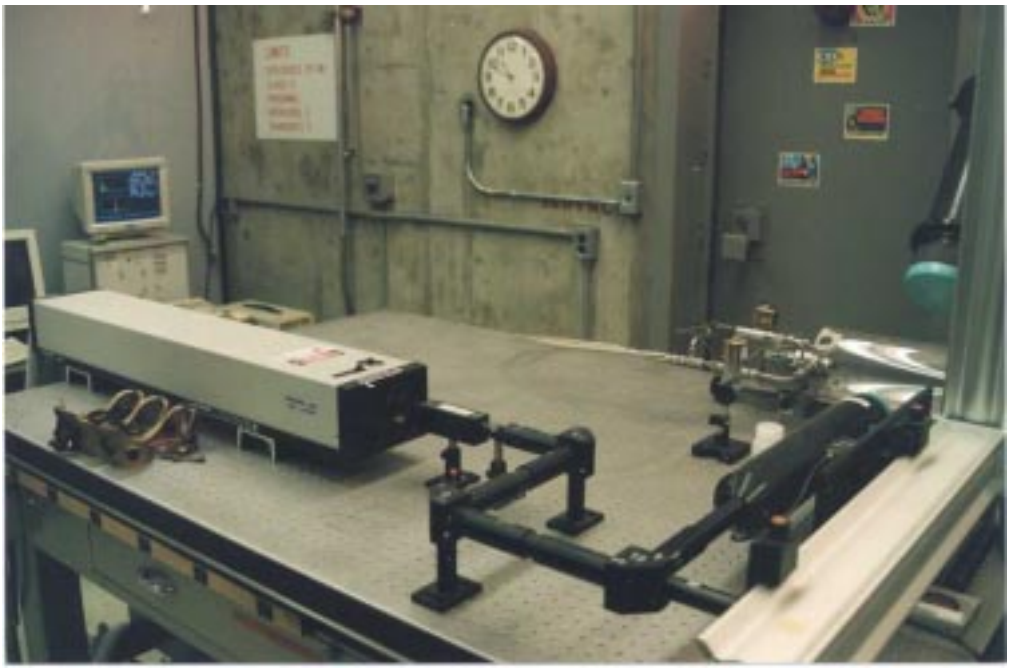
PROPULSION AND COMBUSTION LAB, *continued from page 8*

area network (LAN) exists throughout the lab to allow for the rapid transmission of data and reduce data reduction and processing time. Students working at the lab gain invaluable experience constructing their test apparatus and operating the diagnostic systems related to their thesis and benefit from having access to state-of-the-art equipment.

Distinguished Professor David Netzer began directing the laboratory's operation in 1968. He came to NPS after graduate studies at Purdue University. Previously he worked for the Aerojet General Corporation. Research Assistant Professor Christopher Brophy came to NPS in 1997 as a National Research Council postdoctoral research associate and joined the Aeronautics and Astronautics Department as a research assistant professor last year. Harry Conner, a retired Master Chief with Navy and Coast Guard experience, has been working at RPCL for over 13 years. His experience with facility design and operation, knowledge of various diagnostic systems, and the ability to provide technical assistance to students performing thesis research at the laboratory have proven invaluable during that time.



Phase Doppler Particle Analyzer

The laboratory's layout and facilities provide for a very unique testing capability for an academic institution. The ability to perform hot-fire combustion tests of various propulsion systems while applying advanced diagnostic tools is unique, available only to two or three universities throughout the country. The additional ability to handle classified projects further enhances the laboratory's capabilities and value to the Navy and DoD.

Since the laboratory's inception, a number of combustion and propulsion "firsts" have been accomplished by students, faculty, and visiting researchers:

- First successful operation of a solid fuel scramjet combustor.
- First demonstration of the effectiveness of several smoke-suppressant fuel additives for gas turbine combustors that were subsequently utilized by the Navy.
- First successful operation of a supersonic combustor utilizing a solid-fuel ramjet gas generator.
- First operation of liquid-fueled, pulse-detonation engine using ambient temperature JP-10.
- Determination of the effects of acceleration on the combustion of double-base propellants.
- First experimental measurement of the spatial variation in solid rocket motor plume particulate size.

Current research efforts at RPCL are discussed below.

Plume Signature Characterization and Modification

The recently revived interest in ballistic missile detection and signature prediction has resulted in a program to investigate plume signatures and how they can be modified. A small liquid-fuel rocket engine is used to vary certain operating parameters and quantify the change in the plume characteristics. An infrared (IR) camera is used to image the IR emission and provide spatial information on the engines IR plume signature. Additional information on what species are present in the plume can be obtained through the use of the laboratory's IR spectroradiometer. Since soot (large carbon chains) particles emit a great deal of broadband IR energy, the ability to predict the amount of soot existing in a rocket engine plume is very important. Thesis work by LCDR Zach Scruton, USN, utilizes the IR diagnostics along with a

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PROJECT NOTES

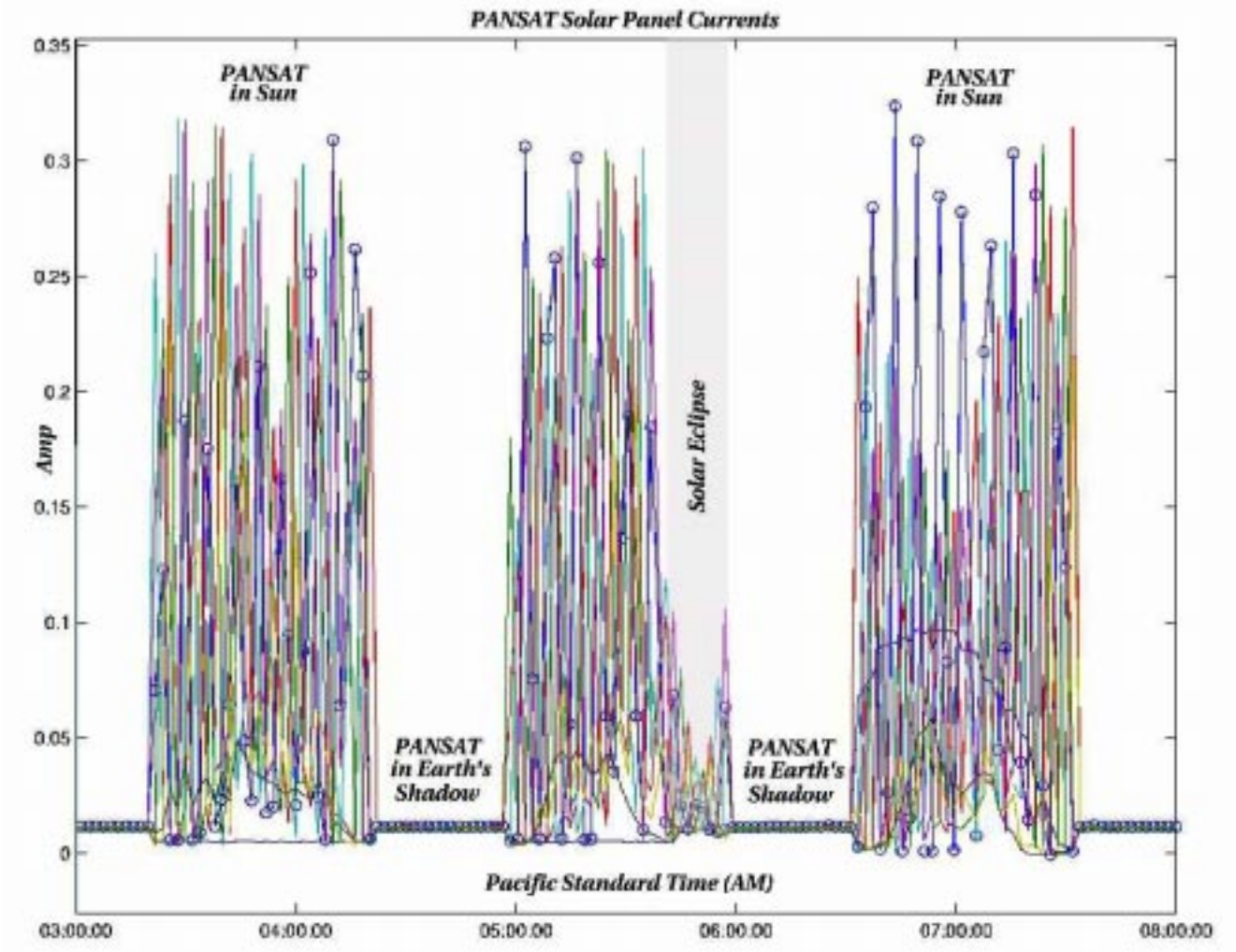
PANSAT FLIES THROUGH SOLAR ECLIPSE

August 11, 1999 offered many viewers a chance to see a total solar eclipse in Europe and Asia. As the moon passed between the Sun and the Earth, its shadow was cast on the ground and traversed across Eurasia from the northwest corner of France at about 3:15 AM (PDT) to the southeast corner of the Black Sea at about 4:30 AM (PDT) before heading toward the southern peninsula of India. What are the odds of a satellite flying through the shadow-cylinder of the moon during the eclipse? One might say the odds are "astronomical."

The NPS Petite Amateur Navy Satellite (PANSAT), flying above the Earth at an altitude of 550 km flew through the shadow of the solar eclipse. PANSAT was launched aboard the *Discovery* Shuttle on the STS-95 mission on October 29, 1998, along with Senator John Glenn. Ten months later, PANSAT's orbit would traverse the path of the solar eclipse while recording the event through its solar panel current sensors. The following figure shows the current output of eight of PANSAT's solar panels. Three orbits are shown as indicated by the peaks of current output. Between the peaks, the satellite flies into its orbit umbra, or shadow created by the Earth. However, careful observation of the middle peak shows an early minimum, or dip, in the current output. This dip shows the decrease in solar panel output due to flying through the solar eclipse just before entering the regular shadowed portion of its orbit. The peaks and valleys shown in the plot while PANSAT is in the sun are due to the tumbling nature of the spacecraft's orientation. Orbit analysis also confirms that the data represented is indeed a result of the solar eclipse.

For a look at PANSAT's ground track and orbital view, see: http://www.sp.nps.navy.mil/pansat/danspans/soleclipse.htm

For more information on the August 1999 solar eclipse, see: http://www.exploratorium.org/eclipse/index.html



PROJECT NOTES

ADAPTIVE ARCHITECTURES FOR COMMAND AND CONTROL RESEARCH TEAM SPONSORS EXPERIMENT WITH CARRIER GROUP ONE

The Adaptive Architectures for Command and Control (A2C2) research project is a multi-disciplinary effort sponsored by the Office of Naval Research. The project's aim is to establish a body of knowledge in current and future joint command and control, and develop and test theories of adaptive architectures. A guiding principle of the A2C2 program is that a practical knowledge of the interactions between the organizational and task (mission) structures is a precursor to the design of flexible organizations. The A2C2 project employs a variety of methodologies including field surveys, empirical research, simulations, and analytical modeling. A key component of the program is a series of model-based, human-in-the-loop experiments conducted at NPS.

Members of the NPS A2C2 Research Team (Associate Professor William Kemple, Research Professor David Kleinmann, Research Assistant Professor Susan Hutchins and Research Assistant Professor Gary Porter of the Command, Control and Communications Academic Group, and Assistant Professor Susan Hocevar, Department of Systems Management) took their research into the field when they recently sponsored a four-day simulation/experiment with RADM David Polatty, Commander, Carrier Group One, and key members of his staff. This event accomplished several major purposes: 1) It provided an opportunity to test the application of modeling and organization design for a more complex mission than is typically used with the student participants in the classroom research experiments; 2) It provided the participants an opportunity to test alternative organization designs for possible use in the Global Wargame to be held at the Naval War College in September 1999 (one of the NPS A2C2 architectures has been selected to be used in the Global Wargame); and 3) It brought together participants from multiple organizations to train together as a Commander Joint Task Force (CJTF) and thus enhance the learning value of the upcoming Global Wargame. Additional participants in this event included representatives from the Naval War College's Global Advanced Research Program, the Marine Corps Combat Development Command, the U.S. Air Force Directorate of Command and Control, Strategic Plans and Policy Division of the USA Deputy Chief of Staff for Operations and Plans, and Commander, Third Fleet.

NPS PROFESSOR LEADS COLLABORATIVE FIELD PROJECT 'MONTEREY STRATUS'

Assistant Professor Qing Wang, Department of Meteorology, served as the lead mission scientist in a collaborative field project, the Monterey Stratus Experiment, from 14 June to 22 July 1999 in the Monterey Bay area. The experiment, sponsored by the National Science Foundation (NSF) and the Office of Naval Research (ONR), was intended to understand the evolution of marine stratocumulus in the complex coastal environments.

The Twin Otter operated by the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) at NPS was the main measurement platform utilized during the experiment. Research aircraft from Sandia National Laboratory and NASA were also involved in the measurements.

The experiment involved scientists from the University of Miami, University of Washington, California Institute of Technology, Colorado State University, and Penn State University.

NPS AWARDED NATIONAL OCEAN PARTNERSHIP PROGRAM (NOPP) GRANT

Associate Professor Tom Herbers and Distinguished Professor Ed Thornton, Department of Oceanography, received a five-year award from the National Ocean Partnership Program (jointly funded by the Office of Naval Research and the National Science Foundation) to develop a wave, circulation and morphology community model for nearshore oceanography. This is a cooperative project involving the University of Delaware, Scripps Oceanographic Institute, Woods Hole Oceanographic Institute, the Naval Research Laboratory, Oregon State University, and the Naval Postgraduate School.

This is NPS' fourth award from the National Ocean Partnership Program.

SENSITIVITY OF SUBMARINE HYPERSPECTRAL CONTRAST

LT Jack Thomas, United States Navy
Masters of Science in Operations Research-September 1999
Advisor: Professor Alan Washburn, Department of Operations Research

(*This is a follow up to a story that appeared in the February 1999 issue of NPS RESEARCH*.) This thesis explores the sensitivity of an airborne Hyperspectral Imager (HSI) used to find near-surface submarines with reflected sunlight and was funded by the Naval Science Assistance Program (NSAP) of the Office of Naval Research (ONR). Through use of a high resolution, physics based model, the radiant light field detectable by such a sensor is simulated. A target representative of a diesel-electric submarine with an Anti-Surface Warfare (ASUW) mission is inserted into the data field. A rudimentary search algorithm is applied to model output to estimate sensor performance (see Figure 1). Statistics are gathered on estimated sensor sweep width given variations in sea state, chlorophyll concentration, and solar zenith angle. Each of these parameters is measurable in flight and known to affect sweep width.

Sea state is a measure of wind speed and swell height, and is a large source of sea surface induced radiance variance. Chlorophyll concentration is an indication of the bio-productivity of the water. Chlorophyll is also highly absorptive, causing large reductions in downwelling irradiance at depth. Finally, solar altitude determines how much sunlight will reflect off the sea surface and how much will transmit into the water column.

Results indicate that chlorophyll concentration has a large impact on sensor sweep width. Over the range of the data (0.0 to 0.4 mg/m^3), the relationship is linear, and small increases in concentration are catastrophic to sweep width. This is unfortunate because a large portion of the littoral areas of the world is highly bio-productive and hence has a high chlorophyll concentration. Chlorophyll concentration also varies over time. Month to month variations can mean the difference between outstanding sweep widths and modest sweep widths in a given area.

Solar altitude affects sweep width in a non-linear fashion. High sun altitudes (≥75°) cause a large glint pattern at the sensor's nadir, so probability of detection in the middle of the sensor's field of view is significantly reduced, creating a so called "high noon hole" (see Figure 2). As the sun traverses the sky from overhead, sweep width at first increases, and then decreases as civil twilight approaches. Indications are that HSIs can expect to be effective down to solar altitudes of 15°. Therefore, although dependent on search latitude and time of year, data indicate that HSIs are useful over a very large portion of the daylight hours.

Sea state also has a strong impact on detection. As sea state increases, glint and whitecaps create surface reflections that can obscure a target. Although this is the case, these reflections can be filtered out, diminishing their negative effects. Indications are that HSIs can expect to be useful up to sea state 3 on the Beaufort scale.

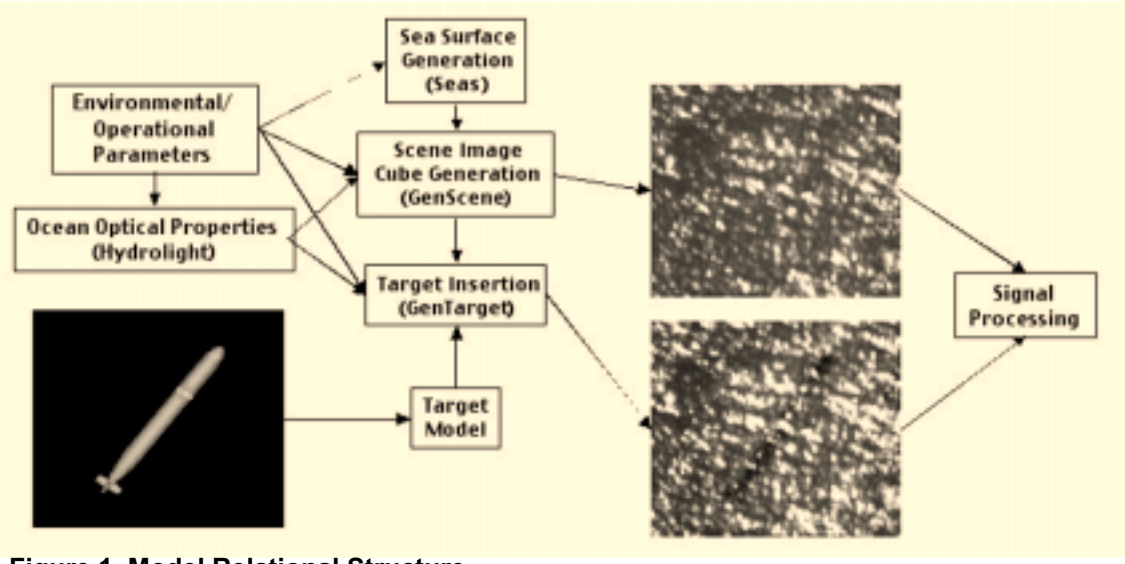


Figure 1. Model Relational Structure

Results from this research indicate that HSIs can expect to have best-case sweep widths on the order of 2,000 yards, providing a coverage rate of 180 nm^2/hr on a fixed-wing aircraft. This makes HSI suitable as a localization and tracking tool, but not as a search sensor.

HSI is very effective against relatively shallow submarines under a somewhat narrow set of environmental parameters. Given that we no longer

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DEVELOPMENT OF A HELICOPTER VORTEX-RING STATE WARNING SYSTEM THROUGH A MOVING MAP DISPLAY COMPUTER

LCDR David J. Varnes, United States Navy
Master of Science in Aeronautical Engineering-Sept. 99
Advisors: Associate Professor Russ Duren and Professor E. Roberts Wood, Department of Aeronautics and Astronautics

(*This is a follow-up to a story that appeared in the June 1999 issue of NPS RESEARCH*). Working in conjunction with the NAWCAD VH Systems Engineering Integrated Product Team, a Vortex-Ring State Warning System has been developed and successfully demonstrated. Plans originally called for demonstrating the warning system on a CH-60 helicopter at Patuxent River. Delays in delivery of the helicopter required the development of a simulation of the CH-60 avionics system. A portable personal computer was equipped with a multi-channel ARINC 429 transceiver and a graphical user interface (GUI) was developed to simulate the helicopter. The aircraft simulator user interface shown in Figure 1 allows the user to specify fuel weights, static air temperature, static pressure, altitude rate, and airspeed. The upper half of the aircraft simulator GUI allows the user to enter the data. Data is sent out over two ARINC 429 buses at the same data rates as on the actual helicopter. Below the GUI input area is a display area that shows the data taken from the appropriate receive channel of the ARINC 429 card. This was instrumental in showing that the data supplied by the user was converted to correct ARINC 429 format and pulled off the ARINC 429 receive channel just as would be done in an actual aircraft implementation. A lunchbox computer housed the ARINC 429 card as well as the Windows-based simulation software.

The Vortex-Ring State (VRS) Monitor was also implemented as a Windows program. It is intended to be run in conjunction with other programs including FalconView

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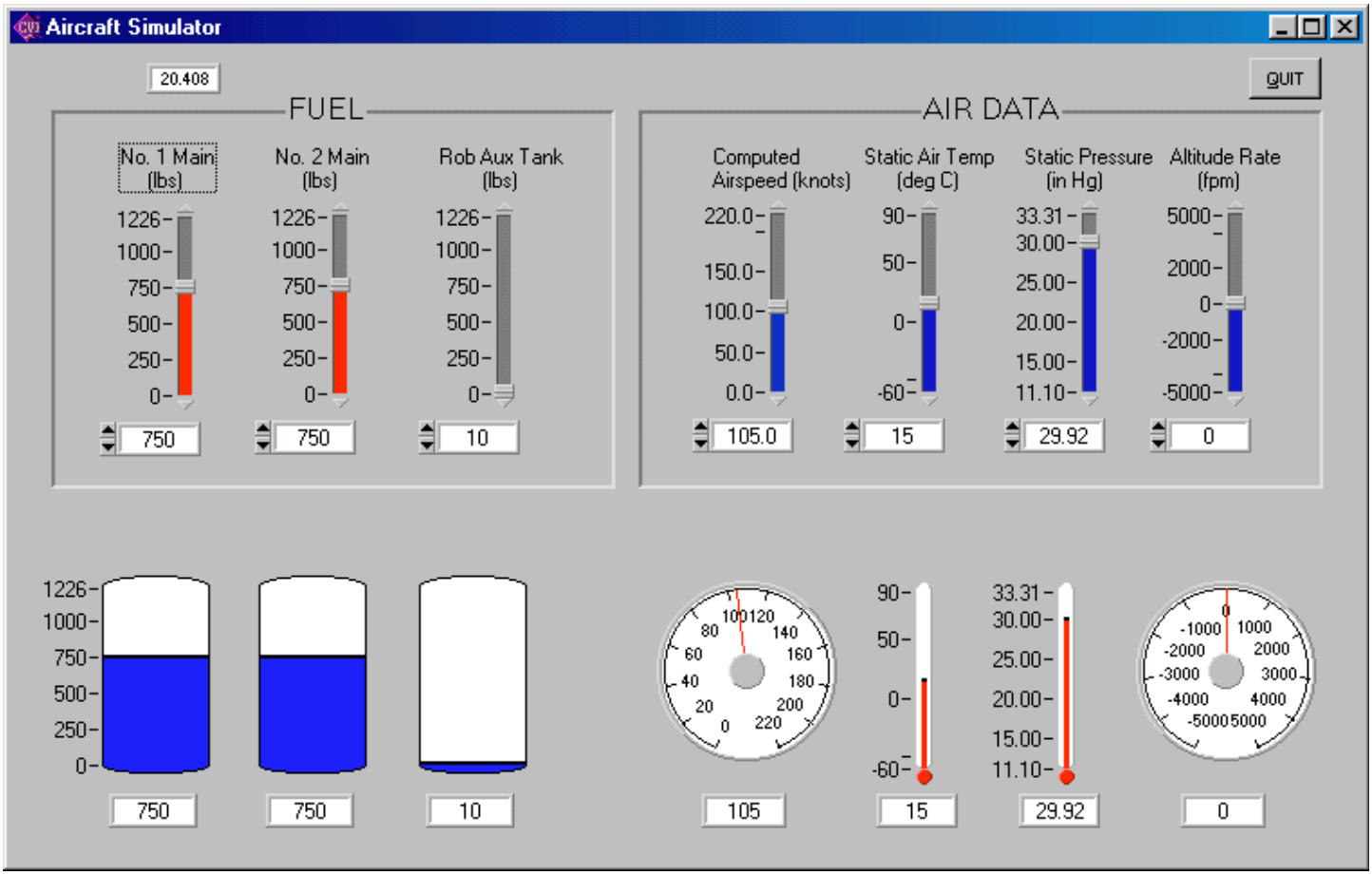
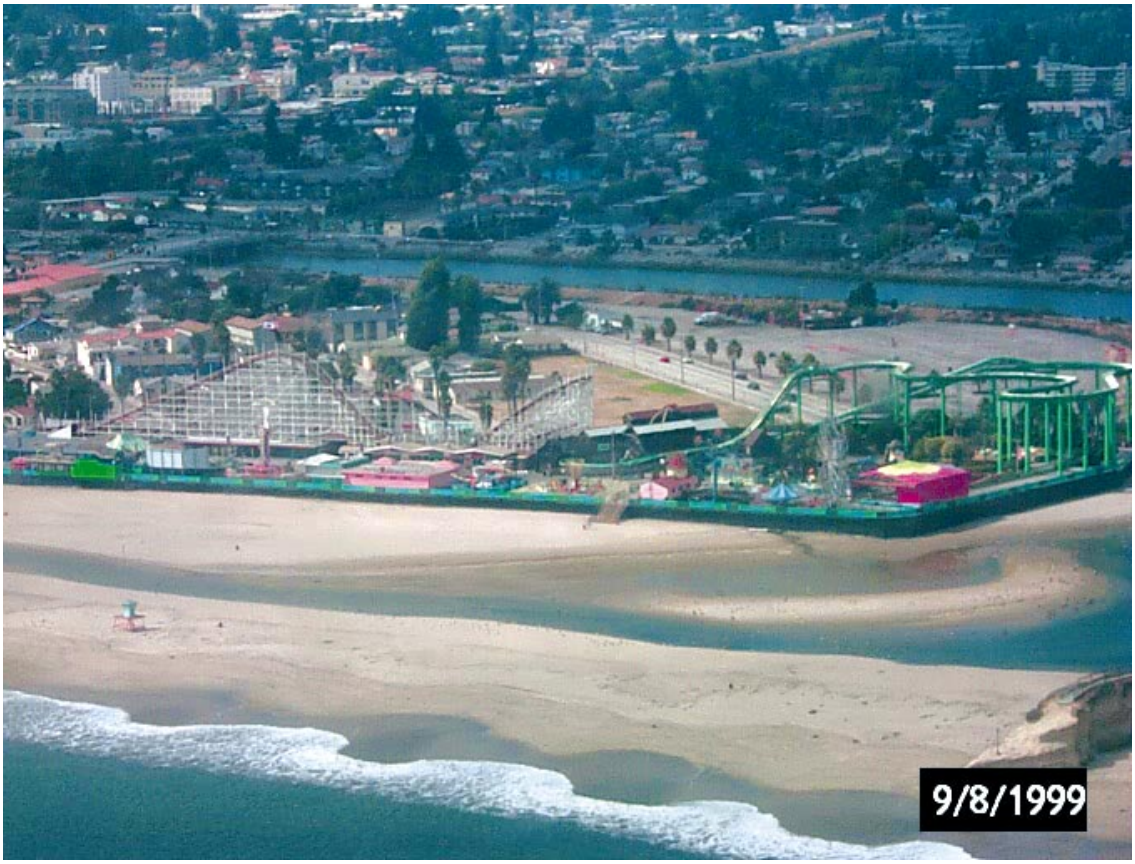


Figure 1. Aircraft simulator

EFFECTIVENESS ANALYSIS OF EA-6B SUPPORT JAMMING WITH A DISTRIBUTED NETWORK OF ELECTRONIC WARFARE-CAPABLE UNMANNED AERIAL VEHICLES

LT Timothy C. Barkdoll, United States Navy
Master of Science in Operations Research-September 1999
Advisors: Distinguished Professor Donald P. Gaver, Department of Operations Research, CAPT James R. Powell, USN, Information Warfare Academic Group, and Professor Alan R. Washburn, Department of Operations Research

The Navy's EA-6B Prowler is the only active support jamming platform in the Joint Force aircraft inventory, and with the third-generation improved capability (ICAP-III) upgrades, the Prowler is slated to be operational until the year 2015. The 2015 projection may be optimistic, but EA-6B follow-on technology is not currently defined. The objective of this thesis was to determine the improvement in jamming effectiveness with a hybrid mix of ICAP-III EA-6Bs operating with a distributed network of EW-capable unmanned aerial vehicles (UAVs). The primary measure of effectiveness is the ratio of the amount of time the strike package is detectable by acquisition radar under jamming conditions to the amount of time the strike package is detectable without the jamming protection. The order of battle is based on a projected Southwest Asian scenario for the year 2010 as published in the Joint Tactical Air Electronic Warfare Study (JTAEWS). This analysis was conducted in three phases representing real-world operational tasking. Phase 1 addressed how accurately each threat can be located as a function of time. The objective of Phase 2 was to determine the optimal beamwidth to employ against each of the threat radar, given location accuracy determined in Phase 1. Applying the results of optimal beamwidth analysis, Phase 3 determined the jamming effectiveness of the hybrid network in terms of protection provided to the strike package using the CONtour RADar (CONRAD) model. The results can be used to assess the practicality of extending the expected service life of the EA-6B through 2015 using a distributed network. In addition, the distributed architecture, implementing currently available technology, can ease the transition to follow-on technology and, as such, should be considered as one possible alternative to the EA-6B follow-on.



LT Rob Moss and LT Steve Tripp flying over Santa Cruz e-mailed this photo to RADM Robert C. Chaplin, Superintendent of the Naval Postgraduate School, via a wireless link to an antenna on top of Ingersol Hall on the NPS campus.

STUDENT RESEARCH

AN AIRBORNE HIGH DATA RATE, MEDIUM RANGE, HIGHLY TRANSPORTABLE AND LOW COST DIGITAL COMMUNICATIONS NETWORK FOR MARITIME PATROL AND OTHER NAVAL AIRCRAFT AND FORCES, USING COMMERCIAL-OFF-THE-SHELF WIRELESS LOCAL AREA NETWORK COMPONENTS

LT Stephen J. Tripp, United States Navy
Master of Science in Systems Engineering-September 1999
Advisors: CAPT J. R. Powell, USN, Information Warfare Academic Group, and Professor Dan C. Boger, Command, Control and Communications Academic Group

Certain National and Navy tasked missions require the rapid dissemination of available data to multiple disparate platforms. Current (commercial-off-the-shelf) COTS technologies can provide for the transmission of such data, using lightweight, low cost ground stations to and from airborne platforms. Additionally, Navy ships and other units with existing large bandwidth communications pipelines can provide and share such with accompanying units using the developed high bandwidth, medium range system. This architecture provides LPD communications for deployed forces with sufficient bandwidth and range to allow for rapid exchange of time critical intelligence and communications both to and from remote locations without the benefit of significant indigenous infrastructure and with minimal possibility of compromise. The small, highly transportable nature of wireless local area Network (LAN) components, combined with the spread spectrum nature of their transmissions makes them desirable as an immediate solution to real-time data sharing requirements.

The objective of this work was to apply a systems engineering process to the selection, evaluation and implementation of a COTS wireless computer network. Both computational and experimental models were analyzed to provide a method for selection and verification of system performance. In-flight evaluation demonstrated the ability to transmit and receive high bandwidth data using the optimized system in a realistic operational environment.

SPECIAL OPERATIONS FORCES TACTICAL INTRANET: LOW PROBABILITY OF DETECTION, LOW PROBABILITY OF EXPLOITATION COMMUNICATIONS FOR SPECIAL OPERATIONS FORCES, USING A COMMERCIAL-OFF-THE-SHELF WIRELESS LOCAL AREA NETWORK

LT Robert B. Moss, United States Navy
Master of Science in Systems Technology-September 1999
Master of Science in Defense Analysis-September 1999
Advisors: Professor Dan C. Boger, Command, Control and Communications Academic Group, and CAPT J. R. Powell, USN, Information Warfare Academic Group

Certain National and Navy tasked Special Operations Forces (SOF) missions require the rapid dissemination of available information to multiple disparate platforms. Current commercially available technologies allow the transmission of such data using lightweight, man portable ground stations with airborne relay platforms. The nature of these missions requires low probability of detection (LPD) communications for deployed forces with sufficient bandwidth and range to allow for rapid exchange of time critical intelligence and communications without indigenous infrastructure and with minimal possibility of compromising the position and intentions of SOF. The small, highly transportable nature of wireless local area Network (LAN) components, combined with the spread spectrum nature of their transmissions makes them appropriate for such scenarios.

The objective of this thesis was to demonstrate the feasibility of currently available commercial-off-the-shelf (COTS) equipment to perform beyond envisioned design parameters, allowing its use in military applications. This demonstration included development of a wireless computer network as a conduit for communications between airborne and ground units. Both ground and in-flight evaluations were performed to determine component configurations, utilizing a Systems Engineering approach to achieve maximum range while meeting minimum throughput requirements.

Lieutenants Tripp and Moss received fellowship awards for their thesis research from the Space and Naval Warfare Systems Center - San Diego (SSC-SD). The SSC-SD fellowship program provides $10,000 to support the student's research. The program was instituted to promote SSC-SD's partnership with NPS, address SSC-SD's research focus areas, lay the groundwork for future technical and project management assignments, and foster long-term professional associations with SSC-SD's technical personnel and management.

STUDENT RESEARCH

ANALYZING THE INTEL PENTIUM'S CAPABILITY TO SUPPORT A SECURE VIRTUAL MACHINE MONITOR

2LT John Scott Robin, United States Air Force
Master of Science in Computer Science-September 1999
Advisors: Assistant Professor Cynthia Irvine, Department of Computer Science, and Steven B. Lipner, Mitretek Systems

This thesis addressed the problem of implementing secure virtual machine monitors (VMM) on the Intel Pentium architecture. A VMM allows multiple operating systems to run concurrently under virtual machines on a single workstation. High-assurance VMMs could allow complete isolation of, or data sharing between, virtual machines according to a security policy such as a mandatory secrecy policy.

The Intel architecture was mapped to a set of hardware requirements for VMMs. It was found that the Intel architecture was not virtualizable. However, several techniques are presented that allow the Intel architecture to support a "virtual VMM." A commercial virtual VMM was studied and found to be unable to support secure VMMs. Therefore, a foundation upon which a secure VMM could be built for the Intel Pentium architecture was presented.

A secure VMM for the Intel architecture offers several benefits. First, PC users could work in a more secure environment. Second, PC users could run familiar COTS operating systems and applications. Finally, secure VMMs could save the DoD millions of dollars by eliminating the need for separate systems when both high assurance, and COTS operating systems and applications are required.

SIMULATION OF A MULTI-TARGET, MULTI-SENSOR, TRACK-SPLITTING TRACKER FOR MARITIME SUVEILLANCE

LT Mark A. Olson, United States Navy
Master of Science in Electrical Engineering-September 1999
Advisors: Professor Harold Titus and Professor Herschel Loomis, Department of Electrical and Computer Engineering

This study adapted some established target tracking techniques for use in the maritime surface surveillance role and tested them with computer generated data. Computer simulation of a track splitting tracker capable of operating in this undersampled and asynchronous environment is presented. The tracker used standard and extended Kalman Filter algorithms to estimate target state from latitude and longitude or line of bearing position measurements. Prior to state estimation, all measurements were processed to retain only those that meet feature and geographic gate thresholds. All measurements passing these criteria updated the target state and were scored based on a goodness-of-fit with the model. The state estimate with the best score was selected as the correct one for display purposes, while all state estimates continue to be processed with subsequent measurements. Several runs of the simulation are discussed in the thesis to illustrate the performance of track splitting and the effect of several key tracker parameters.

STUDENT RESEARCH, *continued on page 35*

Major Eitan Israeli of the Israeli Air Force received his Ph.D. in Operations Research at NPS in March 1999. His dissertation entitled, "Systems Interdiction and Defense," studied the problem of interdicting components of an adversary's system, e.g., a wartime economy, a transportation network, etc. Basic techniques were developed and illustrated with a simple network interdiction problem, "maximizing the shortest path" (MXSP). In MXSP, an interdictor wishes to employ limited interdiction resources as effectively as possible to slow an adversary in moving between two network nodes. Interdiction destroys a network arc entirely or increases its effective length through an attack. This bi-level, max-min problem is formulated as a mixed-integer program (MIP), but unique decomposition algorithms are developed to solve the problem more efficiently than standard branch and bound. One algorithm is essentially Benders decomposition with special integrality cuts for the master problem. A second algorithm uses a new set-covering master problem, and a third is a hybrid of the first two. Techniques were extended to solve: 1) general system-interdiction problems, some of which cannot be formulated as MIPs, 2) system-defense problems where critical components must be identified and hardened against interdiction, and 3) interdiction problems with uncertain interdiction success. Major Israeli's dissertation reported computational experience for MXSP, a shortest-path network-defense problem, and MXSP with uncertain interdiction success.

Since returning to Israel, Major Israeli has been promoted to Lieutenant Colonel and is now head of the Operations Research Group in the Israeli Air Force. Much of his work deals with weapons effectiveness.

NPS LIBRARY DIRECTOR ASSIGNED TO THE DEPARTMENT OF NAVY CHIEF INFORMATION OFFICE (DONCIO) TO DEVELOP KNOWLEDGE PORTAL FOR THE NATIONAL CAPITAL REGION (NCR) AND REVISE SECNAV INSTRUCTION ON LIBRARIES

Professor Maxine Reneker, Director of the Dudley Knox Library, returned to campus on August 23rd after completing a 14-week rotation augmenting the level of activity of the Librarian of the Navy, Joan Buntzen. Her specific assignments, in the DONCIO in Crystal City, were to redraft SECNAV 5070.2B, Management of Naval Libraries, to reflect the substantive changes in the delivery of information to naval commands and to work with the Enterprise Knowledge Group of the DONCIO in the initial design of a Knowledge Portal for the hq.navy.mil Intranet.

The impetus for revision of the SECNAV instruction on libraries stems from the rapid changes in the organization, retrieval, and delivery of information crucial to the duties of naval and civilian personnel, and the creation of new digital tools for managing organizational knowledge. The new instruction, as drafted, is built upon a new framework for the delivery of library and information services to the fleet and shore establishment that moves away from libraries as physical facilities and toward the delivery of information anytime, anywhere.

Revision of the 1991 version of the instruction (SECNAV 5020.2B) involved both re-conceptualizing service delivery and addressing the political issues inherent in a Navy organizational structure which has assigned responsibility for the ship and shore libraries to the Chief of Naval Education and Training (CNET). Furthermore, the function of the Librarian of the Navy has evolved from coordination of physical facilities to the integration of new technologies to facilitate the provision of information across the distributed environment of naval commands. The revised draft instruction emphasizes the naval user, rather than libraries as facilities. The draft instruction is written with a view to increased emphasis on delivery of information via the Naval and Marine Corps Intranet and is general enough to allow easy incorporation of evolving changes in the technologies used to access and deliver information.

NPS Faculty are considered experts in their field and a valuable resource to DoD and DoN agencies. This expertise is accessed mostly via the channels of funded research. On several occasions, however, NPS faculty have been detailed to other Federal organizations to provide full-time support. Highlighted here are three recent or pending assignments.

The second major project during the augmentation was the assessment of knowledge portal tools with a view to developing a Knowledge Portal (KP) for the users of the hq.navy.mil Intranet. The rapidly developing realm of knowledge management and improvements in information delivery technologies, including what is currently termed "knowledge portals," now makes possible the use of off-the-shelf software to bring together internal structured and unstructured organizational information, live feeds off the Internet, and digital library tools.

Knowledge portals contain capabilities such as user profiling, agents which review a source text and calculate the patterns of its most important concepts, applications which maintain a set of multiple concept agents for individual users, and software which extracts key ideas from the article a user reads online, all embedded in a system which keeps pace with an individual's changing interests by recalculating interest levels. Users can create and train agents by typing sample text or referencing existing documents. These concept agents can be applied across different data sets, and the search engine can be trained on patterns in any language.

Maxine Reneker

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NATIONAL SECURITY AFFAIRS PROFESSOR DIRECTS COUNTERPROLIFERATION POLICY FOR THE SECRETARY OF DEFENSE

Dr. Peter Lavoy is an Assistant Professor in the Department of National Security Affairs, but he has spent very little time in Monterey during the past two years. He went to Washington, D.C., in January 1998 to take a short-term position in the Pentagon as an International Affairs Fellow of the Council on Foreign Relations. When the Director of the office in which he worked as a Special Assistant took a job on the NATO International Staff, Dr. Lavoy was asked to extend his stay in the Pentagon and become the Director for Counterproliferation Policy in the Office of the Secretary of Defense.

Under the supervision of Dr. Edward L. Warner, Assistant Secretary of Defense for Strategy and Threat Reduction, and James N. Miller, Deputy Assistant Secretary of Defense for Requirements, Plans and Counterproliferation, Dr. Lavoy directs a staff of seven – three military officers and four civilians.

Although the problems posed by the proliferation of weapons of mass destruction (WMD, or nuclear, chemical and biological weapons) are enormous, Dr. Lavoy's job is straight-forward: (1) to institutionalize the Department's counterproliferation efforts – that is, to ensure that each of the services, unified commands, and other DOD elements are properly prepared to operate effectively against WMD threats; and (2) to internationalize counterproliferation – that is, to help the allies and coalition partners with whom U.S. forces are likely to operate in a major war or small-scale contingency to recognize their own vulnerability to WMD and to undertake efforts to improve the military preparedness of their own forces.

It is in seeking to accomplish the second part of this counterproliferation mission that Dr. Lavoy travels extensively all over the world. Two examples will provide an idea of what he is doing internationally for the Secretary of Defense. As the steering committee co-chair of NATO's Senior Defense Group on Proliferation, Dr. Lavoy was instrumental in negotiating the NATO Weapons of Mass Destruction Initiative (WMDI), an important instrument approved by the heads of state of all 19 NATO allies. This initiative will help the Atlantic Alliance to undertake a thorough assessment of the political-military risks associated with the proliferation of weapons of mass destruction and then implement the political and military policies required to counter these threats.

Dr. Lavoy also has served as the driving force in the development and implementation of the Initiative on Cooperative Defense (CDI) against Weapons of Mass Destruction in Southwest Asia. Supported and advanced personally by Secretary of Defense Cohen and the Commander-in-Chief of U.S. Central Command, GEN Anthony Zinni, this policy directs the U.S. Department of Defense to cooperate with the six states of the Gulf Cooperation Council, Egypt and Jordan to help them identify their vulnerabilities to the use of chemical or biological weapons by regional adversaries and to make the necessary improvements in their military and civil defenses to reduce these vulnerabilities.

Dr. Lavoy's time (and that of his office) is divided fairly evenly between his efforts to improve the preparedness of U.S. forces to operate effectively against WMD threats and his international counterproliferation activities. Therefore, when he returns to NPS in late 2000, he will be able to support both the regional and functional curriculum of the NSA Department. In the meantime, he welcomes visits from any NPS faculty members or students who make their way into the Pentagon. Dr. Lavoy's Office of Counterproliferation Policy is located in room 4B926 of the Pentagon; his number

Dr. Lavoy, right, with his immdiate boss, Dr. James N. Miller, Deputy Asistant Secretary of Defense for Requirements, Plans and Counterproliferation Policy.

MECHANICAL ENGINEERING PROFESSOR IS SELECTED FOR THE WASHINGTON FELLOWS PROGRAM

Associate Professor Knox T. Millsaps of the Department of Mechanical Engineering has been selected to the Washington Fellows Program for 2000. He will serve as a Senior Technical Advisor to the U.S. Senate on matters of technology and national defense for a one-year term, starting January 1, 2000. Every year about 20 specialists in the fields of Medicine, Law, Engineering, Social Policy, Environmental Studies, etc. are chosen to be Congressional Fellows.

Professor Millsaps is the Director of the Marine Propulsion Laboratory in the Department of Mechanical Engineering. He is an expert in energy conversion, propulsion, machinery diagnostics, and signature control. He has an active research program in these areas and is also a consultant to DoD and industry.

Dr. Millsaps joined NPS in 1992 after receiving his Ph.D./Sc.D. in Aeronautics and Astronautics from MIT. He has prior industrial experience with Pratt and Whitney in both Florida and Connecticut in jet and rocket engine research and design. He was a Postdoctoral Fellow (1992) and a Visiting Research Professor (1998) at the Institute of Thermishe Stromungsmachinen, University of Karlsruhe, in Germany. He has published papers in the areas of turbomachinery aerodynamics, heat transfer, and rotordynamic instability.

Knox T. Millsaps

The Dudley Knox Library collections serve the research and instructional needs of NPS students, faculty and staff. The Library supports all NPS curricula with its collections of over one million items including books, bound periodicals, government documents and technical reports.

NPS LIBRARY DIRECTOR, *continued from page 17*

Benefits of the use of Knowledge Portals in an organization are postulated to be: increased productivity by delivering personalized, relevant information to employees, the improved organization of a company's knowledge assets, and the ability to identify other employees with common or similar interests.

During the period of the augmentation, the NCR project evolved from a $60K web page project to a $260K knowledge portal project. During the augmentation, Professor Reneker reviewed the KP software, wrote a statement of requirements and the subsequent statement of work, and identified system integrators capable of developing the knowledge portal and delivering the product as specified. The innovative aspect of this knowledge portal project is the integration of external digital library data with internal organizational databases. The period of development and deployment of the NCR knowledge portal extends from September 1999 through December 2000.

The August 23, 1999 issue of *Federal Times* contains a front page article, "Agencies Tap into Knowledge Sharing," featuring the concept of knowledge sharing in the workplace and discussing the cultural issues which need to be solved for these knowledge portal technologies to be effective.

EDITORS

FACULTY EDITORS

Armed Forces & Society (AF&S) is an interdisciplinary journal that publishes articles on military institutions, civil-military relations, arms control and peacemaking, and conflict management. The journal also publishes reviews of books on a variety of subjects related to the study of armed forces and society. Over fifty nations of the world are represented among the journal's authors, manuscript reviewers, associate editors, and readers—who include political scientists, sociologists, historians, psychologists, legal scholars, and economists, as well as specialists in military organization and strategy. The very wide scope and international read of the journal add to its uniqueness and preeminence as a scholarly resource in the academic community. The journal is sponsored by the Inter-University Seminar on Armed Forces and Society, a forum for the interchange and assessment of research and scholarship in the social and behavioral sciences dealing with the military establishment and civil-military relations.

Journal publications are a primary means for the scholarly exchange of ideas and research results. University faculty members contribute to scholarly publications not only as authors but also as reviewers of the articles submitted for publication by their peers at other institutions

Many NPS professors devote their time serving in editorial positions on the leading journals of their discipline. Serving as an editor-in-chief, however, is like having a second full-time job. It is also indicative of being highly respected in one's field.

Mark J. Eitelberg, a Professor of Public Policy in the Department of Systems Management, serves as the editor-in-chief of *Armed Forces & Society.* An internationally recognized authority on military manpower policy, Professor Eitelberg teaches policy analysis and military sociology/psychology in the Manpower Systems Analysis Curriculum at NPS and in the Leadership Development and Education Program at the U.S. Naval Academy. He has served as an advisor on more than 130 Master's theses and is the author or co-author of over 100 publications and professional papers. During the past several years, his research and writing have focused on issues related to civil-military relations and population participation in the American military.

Mark J. Eitelberg

Armed Forces & Society is published quarterly by Transaction Periodicals Consortium of Rutgers University. Titles and abstracts of articles can be found at http://nuinfo.nwu.edu/ius/afs.htm.

Naval Research Logistics (NRL) is a premier peer-reviewed, international journal in operations research, applied statistics, and general quantitative modeling. Published by John Wiley & Sons in cooperation with the Office of Naval Research, *NRL* has a history of publication of both seminal methodological contributions and innovative applications. The readership includes operations researchers, systems analysts and programmers, economists, and statisticians. The original focus of *NRL* was on naval applications, but this has been greatly expanded over the years to a wide range of civilian and military problems.

Richard E. Rosenthal

NRL accepts about 30% of the articles submitted. Published articles tend to be of the following types: 1) modeling and analysis of problems motivated by current real-world applica-

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FACULTY EDITORS, *continued from page 20*

tions, 2) exploratory modeling and analysis of problems motivated by potential future real-world applications, 3) major methodological advances, and 4) expository pieces of exceptional clarity. Disciplinary areas represented also include probability, statistics, simulation, optimization, game theory, scheduling, reliability, inventory, decision analysis, combat modeling, and others.

The Editorial Board of *Naval Research Logistics* consists of an Editor-in-Chief, 7 Advisory Editors and 44 Associate Editors, who work in many countries throughout the world. Richard E. Rosenthal, Professor and Chairman of the Operations Research Department, is the Editor-in-Chief of *NRL*. His teaching and research interests include optimization and its applications, airlift mobility, transportation and logistics, planning, and algebraic modeling languages. Dr. Rosenthal came to NPS in 1984 to work with Professor Gerald G. Brown as a National Academy of Sciences Senior Postdoctoral Research Fellow. He has also been a Fulbright Lecturer in New Zealand. Dr. Rosenthal is the recipient of several prestigious awards bestowed by the Military Operations Research Society (Rist Prize and Barchi Prize) and the Operations Research Society of America (Koopman Prize). These prizes were awarded for papers on "Optimization Modeling for Airlift Mobility," "Determining the Optimal Mobility Mix," and "Mobilizing Marine Corps Officers." A collection of articles appearing in *Naval Research Logistics* was recently published as a book entitled *Warfare Modeling*, co-edited by Dr. Rosenthal with Jerome Bracken of Yale University and Moshe Kress of Israel's Center for Military Analyses.

Naval Research Logistics is published eight times per year by John Wiley & Sons, Inc. Information on the journal can be found at http://www.interscience.wiley.com/jpages/0894-069X/. *Warfare Modeling* is available through the Military Operations Research Society at www.mors.

Other NPS faculty currently serving in editorial positions include:

Professor Valdis Berzins, Department of Computer Science, associate editor of the *International Journal of Software Engineering and Knowledge Engineering.*

Professor Gerald Brown, Department of Operations Research, associate editor of the *Military Operations Research Journal*.

Associate Professor Rob Dell, Department of Operations Research, associate editor for *Operations Research.*

Professor James Eagle, Department of Operations Research, associate editor for *Naval Research Logistics.*

Assistant Professor Dana P. Eyre, Department of National Security Affairs, book review editor of *Armed Forces & Society*.

Professor Richard Franke, Department of Mathematics, associate editor for *Computer-Aided Geometric Design.*

Professor William Gragg, Department of Mathematics, associate editor for the *Journal of Computational and Applied Mathematics* and *Electronic Transactions on Numerical Analysis*.

Professor Robert Haney, Department of Meteorology, associate editor for the *Journal of Physical Oceanography.*

Associate Professor Debra Hensgen, Department of Computer Science, associate editor for the *Journal of Parallel and Distributed Systems.*

Associate Professor Gregory G. Hildebrandt, Department of Systems Management, book review editor for *Armed Forces & Society*.

Associate Professor Ramakrishna Janaswamy, Department of Electrical and Computer Engineering, associate editor for *Radio Science*.

Professor Larry Jones, Department of Systems Management, co-editor for *International Public Management Journal.*

Associate Professor Young Kwon, Department of Mechanical Engineering, associate editor for *Transactions of the American Society for Mechanical Engineers Journal of Pressure Vessel Technology*.

Associate Professor Siriphong Lawphongpanich, Department of Operations Research, associate editor for *Computational Optimization and Applications*.

Professor Luqi, Department of Computer Science, associate editor for the *Journal of Systems Integration, Design and Process World*, and the *Science of Computer Programming*.

Professor Conrad Newberry, Department of Aeronautics and Astronautics, associate editor (design), for the *AIAA Journal of Aircraft*.

Professor Guillermo Owen, Department of Mathematics, associate editor for the *International Journal of Game Theory.*

Associate Professor I. Michael Ross, Department of Aeronautics and Astronautics, book review editor for the *Journal of Guidance, Control and Dynamics.*

Distinguished Professor David Schrady, associate editor for *Operations Research*.

Research Associate Supachai Siryanone, Department of Meteorology, associate editor for *International Journal of Computers and Mathematics*, the *Journal of Applied Science and Computations*, and *IEEE Transactions on Neural Networks*.

Professor Michael Zyda, Modeling, Virtual Environments, and Simulation Academic Group, senior editor (virtual environments) for *Presence*.

RELATIONSHIPS

LETTER OF INTENT FOSTERS RESEARCH ASSISTANT EXCHANGE PROGRAM WITH FRENCH SCHOOL

A letter of intent has been signed to establish a Research Assistant Exchange Program between the Naval Postgraduate School and the Ecole Nationale d'Ingenieurs De Tarbes (ENIT) in Tarbes, France. Each year during the term of this agreement, each institution may send up to six research assistants to perform directed study at the other institution. The primary purpose of this program is to enable advanced practical work by students in support of collaborative research projects conducted by the Center for Autonomous Underwater Vehicle (AUV) Research at NPS and the ENIT.

MEMORANDUM OF AGREEMENT BETWEEN NPS AND THE TACTICAL CONTROL SYSTEM PROGRAM OFFICE RENEWED

The Memorandum of Agreement (MOA) between NPS and the Tactical Control System (TCS) Program Office was renewed recently. The agreement sets forth the guidelines between NPS and the TCS Program Office to pursue and conduct flight operations related to both TCS and non-TCS objectives. The Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) has been supporting TCS related flight operations since the fall of 1997. The objective of the MOA is to provide for the combining of assets and opportunities of both parties to efficiently leverage their use.

LETTER OF INTENT PARTNERS NPS WITH THE CALIFORNIA STATE UNIVERSITY-CHANNEL ISLANDS (CSU-CI)

A letter of intent between NPS and the California State University-Channel Islands is the result of DoN's push to create more graduate education opportunities for officers, their spouses, and DoN civilian employees. CSU-CI serves the Santa Barbara/Ventura vicinity, an area with a heavy concentration of military personnel. The letter of intent expresses the interest of the parties to pursue cooperative efforts on a variety of distributed learning initiatives, with emphasis on a Masters Degree in Management.

MEMORANDUM OF UNDERSTANDING OUTLINES RESPONSIBILITIES OF NPS' CENTER FOR INTERDISCIPLINARY REMOTELY PILOTED AIRCRAFT (CIRPAS) IN A MISSION WITH THE U.S. BORDER PATROL AND JOINT TASK FORCE SIX

The Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) participated in an operation with the U.S. Border Patrol and Joint Task Force Six. The CIRPAS unmanned aerial vehicle (UAV) known as "GNAT" participated in the mission conducted in September in and around the boot heel region of New Mexico and Arizona. GNAT's forward looking infrared radar (FLIR) capabilities for detection and monitoring were used to determine the drug threat in the area of operation.

RELATIONSHIPS, *continued on page 23*

RADM Rand Fisher, Director, Communications Systems Acquisition and Operations Directorate, National Reconnaissance Office, sat in on the student theses briefings while at NPS for the Space Systems Curricula Review.

CHAIR PROFESSORSHIPS

OFFICE OF NAVAL RESEARCH CHAIR IN ARCTIC MARINE SCIENCE STARTS TWENTY-THIRD YEAR AT NPS

The Arctic Marine Science Chair Professorship was established by Memorandum of Understanding between NPS and ONR in 1976. The Chair Professor is involved in research, including participation in field programs, teaching and thesis advising, and interaction with the naval establishment.

The next incumbent is Professor Andre Proshutinsky from the Institute of Marine Science at the University of Alaska. Under an intergovernmental personnel act (IPA) agreement, Dr. Proshutinsky will begin his residency at NPS in October. Dr. Proshutinsky is currently the Wadati Chair Professor in Global Change Studies at the University of Alaska. Prior to joining the University of Alaska, Dr. Proshutinsky had a long and distinguished career at the Arctic and Antarctic Research Institute (ARRI) in St. Petersburg, Russia. Dr. Proshutinsky is well known for his work in climate dynamics using coupled ice-ocean-atmosphere models. His strong background in observational oceanography has given him the expertise and appreciation for remotely sensed and in-situ observations to constrain, validate and interpret model output. His efforts during the past several years have been directed towards the seasonal and decadal-scale variability of the Arctic System.

During his tenure in the Chair, Dr. Proshutinsky will collaborate with NPS Professor Albert Semtner and his colleagues in their efforts to develop a very high-resolution air-sea-ice model (see *NPS RESEARCH*, Vol. 9, No. 2). He will also continue his on-going investigation of global climate change, provide lectures and seminars to the faculty and students at NPS, assist in teaching the Polar Oceanography Course, and act as a thesis advisor.

RELATIONSHIPS, *continued from page 22*

MEMORANDUM OF AGREEMENT BETWEEN NPS AND THE ASIA-PACIFIC CENTER FOR SECURITY STUDIES (APCSS) FOSTERS MUTUAL SUPPORT PROGRAM

An agreement between NPS and APCSS establishes a program of support between the two organizations that will augment their capabilities. The agreement allows for the occasional exchange of personnel between the two commands and the establishment of joint research and conference activities on security related issues (peacekeeping, regional security and force structure) in the Asia-Pacific Region.

NATIONAL RECONNAISSANCE OFFICE CHAIR PROFESSORSHIP ESTABLISHED

A Memorandum of Agreement has recently been signed to establish a National Reconnaissance Office (NRO) Chair Professorship at NPS. Partners to the agreement include NPS, NRO and The Aerospace Corporation. The NRO has for several years sponsored research at NPS. Additionally, Aerospace in its role as operating a Federally Funded Research and Development Center (FFRDC) provides in-depth technical support to the NRO.

After a series of visits and discussions by NRO with Professor Rudolf Panholzer, Chair of the Space Systems Academic Group, it was decided that a chair professorship sponsored by NRO and filled by Aerospace would facilitate achievement of the NRO's technical objectives. NPS also recognized the advantages for its students if such an arrangement could be realized. The Chair Professor will teach selected courses, serve as a thesis advisor to NPS students, and support conferences, workshops or symposia, and seminars when appropriate.

Dr. Alfred Sorensen of The Aerospace Corporation has been designated to represent the NRO for the purpose of carrying out the responsibilities of the Chair Professor. Prior to his assignment at NPS, Dr. Sorensen served on the executive staff to the President and CEO of The Aerospace Corporation, and was the Principal Director of the Integrated Information System Office. Dr. Sorensen has been actively involved in most MILSATCOM program development efforts and has coordinated various development programs in advanced communications, microelectronics, IR focal planes, space power, cryogenic refrigerators, and exo-atmospheric kinetic energy interceptors. Dr. Sorensen has more than thirty years of industrial, teaching, and research experience.

While occupying the NRO Chair Professorship, Dr. Sorensen plans to provide a strong interface between NPS and the NRO on issues of research and funding support, support NPS space and satellite development efforts with Aerospace technical expertise and pursue potential collaborative research, provide an interface and solicit support for NPS space efforts from the commercial space industry, and couple NPS with the University of Southern California and University of California-Los Angeles, in the establishment of the Center for InfoSysMatics.

NPS RESEARCH LEADS TO PATENTABLE IDEAS

The most common vehicle for technology transfer of NPS research is publication. In some cases, however, faculty research leads to a patentable idea. Several patent applications have recently been filed in addition to the issued patents reported here.

Associate Professor Phillip Pace of the Department of Electrical and Computer Engineering has filed a patent application with co-inventors R.E. Surratt, Naval Research Laboratory, and S-Y Park of Singapore (Navy Case No. 79,429). Their invention focuses on a method and system for signal processing especially useful as a signal repeater, i.e., for simulating the characteristic echo signature of a preselected target. The system has a digital radio frequency memory (DFRM) and associated circuitry, including digital tapped delay lines and a modulator in each delay line to impose both amplitude and frequency modulation in each line. Use of digital semiconductor technology increases the bandwidth and sensitivity of such a repeater over prior analog based systems, reduces the noise of the repeated signal, reduces size and costs of such a system, and permits real time alteration of operating parameters permitting rapid and adaptive shifting among different kinds of targets being simulated. Preferably, the associated circuitry is unitary with and part of the DRFM.

Other patent applications include those filed by Associate Professor Thomas Hofler, Department of Physics, on a "Heat Driven Acoustic Power Source Coupled to an Electric Generator," (Navy Case No. 82020), and Research Associate Professor Timothy P. Stanton, Department of Oceanography, on a "Turbulence-Resolving Coherent Acoustic Sediment Flux Probe Device and Method," (Navy Case No. 77525).

TWO-PHASE DYNAMIC LOGIC CIRCUITS FOR GALLIUM ARSENIDE COMPLEMENTARY HIGFET FABRICATION (U.S. PATENT No. 5,926,038)

Inventors: Associate Professor Douglas J. Fouts, Department of Electrical and Computer Engineering, and Khaled Ali Shehata, Giza, Egypt

A two-phase dynamic logic circuit for complementary GaAs HIGFET fabrication processes has a precharge transistor connected between a precharge voltage source and an output node of the logic circuit. The precharge transistor is controlled by a clock signal such that the output node precharges when the clock signal is low and is isolated from the precharge voltage source when the clock signal is high. An evaluate transistor connected to the output node and an NFET logic block has a first terminal connected to the evaluate transistor such that the evaluate transistor is between the NFET logic block and the output node. A second terminal of the logic block is connected to a voltage source and a data input terminal that is arranged to receive data input signals. The NFET logic block includes one or more transistors arranged to generate a logic value. The evaluate transistor is controlled by the clock signal such that when the clock signal is low, the output node is isolated from the NFET logic block, and when the clock signal is high, the logic value generated by the logic block is allowed to determine the voltage on the output node of the logic circuit. A pass-gate is arranged to receive an input signal and conditionally pass the input signal to the gate(s) of the transistor(s) in the NFET logic block under the control of the clock signal such that the input is allowed to influence the gate voltage of the evaluation transistor when the clock signal is low, but is not allowed to influence the gate voltage of the transistor(s) in the logic block when the clock signal is high.

HIGH-EFFICIENCY HEAT-DRIVEN ACOUSTIC COOLING ENGINE WITH NO MOVING PARTS (U.S. Patent No. 5,901,556)

Inventor: Associate Professor Thomas J. Hofler, Department of Physics

This invention describes a new geometry for a heat driven thermoacoustic prime mover (i.e. acoustic motors) and its application to a thermoacoustic refrigerator and to an electricity generator. The heat driven acoustic refrigerator has no moving parts, and is thus extremely reliable, simple, and cheap to manufacture. Unlike previous heat driven acoustic cooling engines, it has good efficiency and compactness and is easy to start, avoiding destructively high temperatures upon start-up. The cooling engine is saleable over an extremely wide range of cooling capacities from integrated circuit and sensor cooling to building air conditioning. The electricity-generating engine has modest efficiency, but may be attractive in remote applications where high-reliability or low cost or low environmental noise or solar powering is important. The generator is likely to be most attractive in capacities of a few kW to below 100 W where a tiny engine would be impractical using other technologies.

TECHNOLOGY TRANSFER,
-- continued on page 35

CONFERENCES/WORKSHOPS

INFLUENCING THE MOTIVATIONS OF WEAPONS OF MASS DESTRUCTION (WMD) STATES: NEW DIRECTIONS IN NONPROLIFERATION AND COUNTERPROLIFERATION

Assistant Professor Peter Lavoy, who is currently serving as the Director for Counterproliferation Policy in the Office of Secretary of Defense (OSD), and Associate Professor James J. Wirtz of the Department of National Security Affairs recently hosted a conference on bridging the gap in U.S. nonproliferation, counterproliferation and deterrence policy. The conference, held on 18-20 August 1999, attracted over one hundred participants for a discussion on how to reduce the motivations of various countries to acquire and use weapons of mass destruction. Officials from the intelligence community, United States Central Command, OSD, the Defense Threat Reduction Agency, national laboratories, the State and Commerce departments, Congressional staffs, and members of the academic community attended the conference.

A variety of presentations and papers were delivered at the meeting. Participants discussed the implications of the recent nuclear tests conducted by India and Pakistan. A former Iraqi nuclear scientist and a leading scholar of the Israeli nuclear program also discussed the preventive strike against the Osirak reactor.

Another highlight of the conference was the opportunity to conduct a lively lunchtime exchange with Admiral Richard Meis, Commander-in-Chief, United States Strategic Command. While at the Naval Postgraduate School Admiral Meis received a research brief from several students in the National Security Affairs Department. He also delivered a classified briefing to students in the Special Operations, National Security Affairs and Operations Research curricula.

The conference was sponsored by the DCI Nonproliferation Center, Naval Information Warfare Activity, USAF Institute of National Security Studies and the Center for Nonproliferation Studies, Monterey Institute of International Studies. Professors Wirtz and Lavoy intend to edit the papers presented at the conference for publication in 2000.

SHALLOW WATER ACOUSTIC MODELING (SWAM '99) WORKSHOP

Assistant Professor Kevin Smith, Department of Physics, organized a three-day workshop on shallow water acoustic modeling at NPS in September. Co-sponsored by the Office of Naval Research and NPS, the objectives of the workshop were to provide an opportunity for the underwater acoustics modeling community to share their latest techniques and compare their results for a variety of synthetic environments. The goal is to determine which shallow water environmental factors present difficult challenges for current propagation codes and what details are important for accurate, yet efficient, solutions. Papers presented at the meeting addressed a variety of shallow water variability issues for both single frequency (CW) and broadband (pulse) propagation. The 30 attendees represented government and DoD labs as well as academia, both domestic and international. There are plans for a follow-on workshop combining propagation and inversion in 2001. The workshop was very successful with surprising results presenting new challenges for future modeling efforts. Papers presented at the workshop are being compiled for refereed publication in a book to be co-edited by Professor Smith.

DEFENSE MODELING AND SIMULATION OFFICE SHORT COURSE HELD AT NPS

The Defense Modeling and Simulation Office, hosted by Professor Mike Zyda, Chair of the MOVES (Modeling, Virtual Environments, and Simulation) Academic Group, presented a four hour short course at NPS on 16 July 1999. The objective was to provide a broad understanding of DoD Modeling and Simulation (M&S) terms, concepts, organizations, activities, and issues. Points of interest in all three DoD M&S functional areas of Training, Analysis, and Acquisition were addressed. The attendees included students from the MOVES curriculum.

Associate Professor Wendell Nuss and Research Assistant Professor Doug Miller of the Department of Meteorology recently hosted a workshop of National Weather Service Science Officers, NOAA researchers, state and local emergency managers, and others to begin planning for a field study off the U.S. West Coast to examine how to better forecast heavy precipitation. The field program would likely take place in January and February 2001 and will utilize NOAA research aircraft and ships. The effort is aimed at putting the new observations into the operational weather offices to have an immediate benefit on forecast accuracies. The effort will also benefit long term ongoing research efforts. The field program is referred to as PACJET or the Pacific Landfalling Jets Experiments.

FACULTY NEWS

AERONAUTICS AND ASTRONAUTICS

S. K. Hebbar, M. F. Platzer, and M. H. Kristy, "Strut and Wall Influence on the Ground-Plane Flow of a Hovering STOVL Aircraft," (AIAA Paper No. 99-3221), *Proceedings of the 17th Applied Aerodynamics Conference,* Norfolk, VA, 28 June–1 July1999.

K. D. Jones, S. Davids, and M. F. Platzer, "Oscillating Wing Power Generation," (Paper No. ASME-FEDSM99-7050), Third ASME/JSME Joint Fluids Engineering Conference, San Francisco, CA, 18-23 July 1999.

C. Newberry, "Incorporating Risk into the Conceptual Design Process," and "Global Environmental Security," ASEE Annual Conference and Exposition, Charlotte, NC, 20-23 June 1999.

C. Newberry, "Global Environmental Security," ASEE Annual Conference and Exposition, Charlotte, NC, 20-23 June 1999.

M. F. Platzer gave a lecture on, "Computational and Experimental Investigations of Flapping Airfoil Propulsion and Power Generation," at the German Armed Forces University, Munich, Germany, on 25 June 1999.

S. Weber and M. F. Platzer, "Steady and Dynamic Stall Analysis of the NLR-7301 Airfoil," (ASME-IGTI Paper No. 99-GT-21), International Gas Turbine Congress, Indianapolis, IN, 7-10 June 1999.

COMPUTER SCIENCE

M. Harn, V. Berzins, and Luqi, "Computer-Aided Software Evolution Based on Inferred Dependency," Conference on Advanced Information Systems Engineering; Sixth Doctoral Consortium, Heidelberg, Germany, 14-15 June 1999.

M. Harn, V. Berzins, and Luqi, "A Dependency Computing Model for Software Evolution," Eleventh International Conference on Software and Knowledge Engineering, Kaiserslautern, Germany, 17-19 June 1999.

J. Guo and Luqi, "Object Modeling to Re-Engineer Legacy Systems," *Proceedings of the Eleventh Conference on Software Engineering and Knowledge Engineering*, Kaiserslautern, Germany, 17-19 June 1999.

M. Harn, V. Berzins, and Luqi, "Evolution of C41 Systems," Command and Control Research and Technology Symposium, U.S. Naval War College, Newport, RI, 29 June–1 July 1999.

M. Harn, V. Berzins, and Luqi, "Computer-Aided Software Evolution Based on a Formal Model," Thirteenth International Conference on Systems Engineering, Las Vegas, NV, 9-12 August 1999.

M. Harn, V. Berzins, and Luqi, "A Formal Model for Software Evolution, Third International Conference on Computational Intelligence and Multimedia Applications," New Delhi, India, 23-26 September 1999.

M. Harn, V. Berzins, and Luqi, "Software Evolution Process via a Relational Hypergraph Model," IEEE/IEEJ/JSAI International Conference on Intelligent Transportation Systems, Tokyo, Japan, 5-8 October 1999.

C. Irvine has been appointed to the Information System Security Science and Technology Study Group chartered by the Information Security Research Council. The Group is charged with the development of a vision of an information security and Information Assurance (IA) operational end-state for a time period of 10 to 20 years in the future.

N. Rowe served as General Chair of the Fourth ACM Conference on Digital Libraries held in Berkeley, CA, 11-14

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Research Assistant Professor Wolfgang Baer, Department of Computer Science, has recently been appointed to the Technical Advisory Committee in a U.S. Army Research Office (ARO) sponsored Multi-disciplinary University Research Initiative on the subject of "Information Physics: Non-classical Information Representation and Manipulation."

Two teams, one from Stanford and Rutgers University and the other from the University of Rochester and Cornell University, have been awarded five-year contracts to explore the theory and develop proof of principle demonstrations in the non-classical regimes. The work will explore foundations in the growing field of quantum information science, including quantum computing, quantum communications, quantum memory, and quantum cryptography.

If Moors law continues to hold, the computer industry will hit the quantum limit in approximately 15 years. We can either look at this limit as an evil to be avoided or as a blessing to be exploited. Researchers in the field of quantum information are hoping that the properties of nature below the quantum limit if properly harnessed will lead to devices operating at speeds exceeding current capabilities by many many orders of magnitude.

Quantum research at NPS is a joint undertaking between professors in the Departments of Physics and Computer Science. Several thesis have resulted from this effort so far. It is an exciting field. " Quantum computers are the atomic bomb of the information age," according to Professor Baer, " but it will take a miracle to build one." For computer scientists that miracle is a new understanding of classic concepts such as information, computation, and algorithm. It is not going to be easy.

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August 1999. This scientific conference addressed the technology and management of electronic documents as on the World Wide Web. Attendees included software developers and librarians.

ELECTRICAL AND COMPUTER ENGINEERING

F. Carlson and J. McEachen, "OPNET Performance Simulation of the Kerberos Protocol in a Single Ticket Granting Server (TGS) Network," OPNETWORK '99, Washington, D.C., 1 September 1999.

P. Eichel and R. Ives, "Compression of Complex-Valued SAR Images," *IEEE Transactions on Image Processing*, October 1999

R. Hippenstiel and U. Aktas, "Difference of Arrival Estimation Using Wavelet Transforms," 42nd Midwest Symposium on Circuits and Systems, Las Cruces, NM, 8-11 August 1999.

R. Ives, P. Eichel and N. Magotra, "A New SAR Image Compression Quality Metric," 42nd Midwest Symposium on Circuits and Systems, Las Cruces, NM, 8-11 August 1999.

R. Janaswamy served on the Technical Programs Committee of the 1999 Joint IEEE Antennas and Propagation Symposium/URSI Meeting held in Orlando, FL, July 1999.

R. Janaswamy and M. Motta, "Low Grazing Angle Forward Propagation Over Rough Surface Using Parabolic Equation," XXIVth General Assembly of URSI, Toronto, Canada, August 1999.

P. Kontodios, R. Hippenstiel, and T. Ha, "Performance of Non-Coherent BFSK in a Nakagami Fading Channel Using Equal Gain and Post Detection Selection Combining," Second IEEE Workshop on Signal Processing Advances in Wireless Communications, Annapolis, MD, 9-12 May 1999.

J. McEachen and M. Batson, "Modeling Cache Inconsistencies in a High-speed Network Interface," IEEE Midwest Symposium on Circuits and Systems, Las Cruces, NM, 10 August 1999.

J. McEachen and M. Batson, "Performance Analysis of an ATM High-Speed Network Interface," IEEE International Conference on Electronics, Circuits and Systems, Paphos, Cyprus, 6 September 1999.

H. Tan and R. Janaswamy, "Effect of Mutual Coupling on the Performance of Adaptive Arrays," 1999 Joint IEEE Antennas and Propagation Symposium/ URSI Meeting, Orlando, FL, July 1999.

J. S. Tyo, C. Buchenauer, and J. Schoenberg, "Beamforming in Time Domain Arrays," 1999 IEEE AP-S International Symposium, Orlando, FL, 7-11 July 1999.

J. S. Tyo and T. Turner, Jr., "Imaging Spectropolarimeters for Use in Visible and Infrared Remote Sensing," Imaging Spectrometry V, SPIE Annual Meeting, Denver, CO, 19-21 July 1999.

J. S. Tyo, C. Buchenauer, J. Gueits, and J. Schoenberg, "Artificial Materials for Time-Domain Applications," 1999 URSI General Assembly, Toronto, Canada, 13-21 August 1999.

X. Yun, E. Bachmann, R. McGhee, R. Whalen, R. Roberts, R. Knapp, A. Healey, and M. Zyda, "Testing and Evaluation of an Integrated GPS/INS System for Small AUV Navigation," *IEEE Journal of Oceanic Engineering*, Vol. 24, No. 3, July 1999.

INFORMATION SYSTEMS

B. Kitchenham and N. Schneidewind, et al., "Towards an Ontology of Maintenance," Technical Report TR99-03, University of Keele, Keele, UK, March 1999.

A. Nikora, N. Schneidewind, and J. Munson, "Practical Issues in Estimating Fault Content and Location in Software Systems," *Proceedings of the AIAA Space Technology Conference and Exposition*, Albuquerque, NM, 29-30 September 1999.

N. Schneidewind, "Measuring and Evaluating the Development and Maintenance Process Using Reliability, Risk, and Test Metrics," International Conference on Software Maintenance, Oxford, UK, 31 August 1999.

N. Schneidewind, "Software Maintenance is Nothing More Than Another Form of Development," *Proceedings of the International Conference on Software Maintenance*, Oxford, UK, 1 September 1999.

N. Schneidewind, "Software Quality Maintenance Model," *Proceedings of the International Conference on Software Maintenance*, Oxford, UK, 2 September 1999.

N. Schneidewind, "Presenting Research Results," International Workshop on Empirical Studies of Software Maintenance '99, Oxford, UK, 4 September 1999.

N. Schneidewind, "Software Quality Maintenance Model," International Conference on Software Maintenance, Oxford, UK, 2 September 1999.

MATHEMATICS

D. Canright, D. Danielson, D. Perini, and P. Schumacher, Jr., "The Naval Space Command Differential Correction Process," AAS/AIAA Space Flight Mechanics Meeting, Alaska, 17 August 1999.

B. Neta and F. Giraldo, "Stability Analysis for Eulerian and Semi-Lagrangian Finite Element Formulation of the Advection-Diffusion Equation," *Computers and Mathematics with Applications*, Volume No. 38, pp. 97-112.

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FACULTY NEWS

Distinguished Professor Turgut Sarpkaya, Department of Mechanical Engineering, has been presented the Distinguished Service Award by the American Institute of Aeronautics and Astronautics for his contributions to Atmospheric Flight Mechanics (AFM). AFM deals with the taking off and landing of large aircraft in the turbulent wake of each other, with the minimization of the separation time or distance between them, and with other issues such as the increase of the efficiency of the airports, reduction of the fuel costs, and the increase in flight safety.

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MECHANICAL ENGINEERING

A. Alessandri, A. Healey, and G. Veruggio, " Robust Residual Generation for Detection of Actuator and Sensor Faults in Unmanned Vehicles," Unmanned Underwater Submersible Technology Symposium, Durham, NH, 22-26 August 1999.

A. Gopinath and S. Isik, "Separation Mechanics of Thin Interfacial Liquid Layers," Conference on Interfaces for the 21st Century, Monterey, CA, 16-18 August 1999.

R. Hashimoto, E. Menon, and J. Fiorillo, "Analysis of Metallic Pigments Used in 19th Century Japanese Prints," *Proceedings of Microscopy and Microanalysis '99*, Portland, OR, 1-5 August 1999.

R. Hashimoto, E. Menon, and A. Fox, "Segregation of Silicon in Metal-Alumina Composites," *Proceedings of Microscopy and Microanalysis '99*, Portland, OR, 1-5 August 1999.

A. Healey received a Certificate of Appreciation from the American Society of Mechanical Engineers for his leadership in the Systems and Design Technical Group.

Y. Kwon was elected as Fellow of the American Society for Mechanical Engineers.

E. Menon, T. Halladay, A. Fox, and R. Mahapatra, "Microstructural Developments in Chill-Cast and Directionally Solidified Ti-44AI-11Nb Alloys," *Proceedings of Microscopy and Microanalysis '99*, Portland, OR, 1-5 August 1999.

R. Nagarajan, A. Fox, E. Boakye, and R. Hay, "Analytical Electron Microscopy Investigation of Coated 3M Nextel 720 Fibers," *Proceedings of Microscopy and Microanalysis '99*, Portland, OR, 1-5 August 1999.

J. Riedel, A. Healey, D. Marco and B. Beyazay, "Design and Development of Low Cost Variable Buoyancy System for the Soft Grounding of Autonomous Underwater Vehicles," Unmanned Underwater Submersible Technology Symposium, Durham, NH, 22-26 August 1999.

J. Riedel and A. Healey, "Estimation of Directional Wave Spectra from an Autonomous Underwater Vehicle," Unmanned Underwater Submersible Technology Symposium, Durham, NH, 22-26 August 1999.

T. Sarpkaya gave six hours of specialized lectures on "Time-Dependent-Flow Forces Due Loss of Coolant Accidents and/or Safety-Relief-Valve Discharge Accidents on Structures Immersed in the Pressure Suppression Pools of Boiling-Water Nuclear Reactors," to the Reactor Safety Division of the Nuclear Regulatory Commission in Washington, D.C., on 7 September 1999.

METEOROLOGY

P. Frederickson, K. Davidson, C. Zeisse, and C. Bendall, "Near-Surface Scintillation Over the Ocean," *Propagation and Imaging Through the Atmosphere III, SPIE Proceedings*, Vol. 3763, Denver, CO, 22-23 July 1999.

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Professor Anthony J. Healey, Department of Mechanical Engineering, represented NPS at the First Australian-American International Conference on the Technology of Mines and Mines Countermeasures in Sydney Australia, 12-16 July 1999. The conference was jointly sponsored by the Defense Science and Techology Organisation (Australia), the Naval Facilities Engineering Command, Pacific Division, the Mine Warfare Association, the Wilson Institute for Demining and Humanitarian Assistance, and NPS.

Professor Healey presented the paper, "Multiple Autonomous Vehicle Solutions to Minefield Reconnaissance and Mapping," which appears in the conference proceedings. The paper emanates from Dr. Healey's work funded by the Office of Naval Research on modeling and simulation of multi-robot control strategies for unexploded ordnance (UXO) and mine clearance operations. As part of his work on very shallow water (VSW) mine countermeasures, Dr. Healey is developing an understanding of the MEDAL software in use by the Fleet to provide tactical decision aids for the use of multi-vehicle solutions. Wave and current forces are also being modeled in collaboration with the Coastal Systems Station-Panama City for small swimming and crawling robots operating in the VSW regions.

FACULTY NEWS

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P. Frederickson and K. Davidson, "Measurement and Modeling of Near-Ocean Surface Properties Affecting Aerosol Concentration Profiles During EOPACE," *Proceedings of the European Aerosol Conference*, Prague, Czech Republic, 6-10 September 1999.

H. Kuo, R. Williams, and J. Chen, "A Possible Mechanism for the Eye Rotation of Typhoon Herb," *Journal of the Atmospheric Sciences*, Vol. 56, 1 June 1999.

H. Kuo, T. Leou, and R. Williams, "A Study on the High Order Smolarkiewicz Methods," *Computers and Fluids*, Vol. 28, 1999.

M. Peng, B. Jeng, and R. Williams, "A Numerical Study on Tropical Cyclone Intensification, Part I: Beta-Effect and Mean Flow Effect," *Journal of the Atmospheric Sciences*, Vol. 56, 1999.

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION (MOVES)

S. Singhal and M. Zyda, *Networked Virtual Environments*, Addison-Wesley, July 1999.

NATIONAL SECURITY AFFAIRS

R. Looney and D. Winterford, "Advanced Telecommunications and the Economic Diversification of Bahrain," *Telecommunications in Western Asia and the Middle East*, pp. 223-235, Oxford University Press, 1999.

L. Lawson, "External Democracy Promotion in Africa: Another False Start?" *Commonwealth and Comparative Politics*, Vol. 37, No. 1, 1999.

Last year, Assistant Professor Robert A. Koyak, Department of Operations Research, was invited to testify before the Subcommittee on the Census, House Government Reform and Oversight Committee, along with seven or eight other statisticians and demographers about the plan for the 2000 census. Professor Koyak's testimony focused on weaknesses in the plan's use of statistical sampling. Over the last year much has changed with the 2000 census plan, including a January 1999 Supreme Court ruling that voided much of the use of sampling in the census. The plan as it exists today calls for a much reduced usage of sampling. The controversy over the use of sampling in the 2000 Census continues, but in a different form than as recently as a year ago.

OCEANOGRAPHY

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This Summer the Department of National Security Affairs initiated an upper division course in Environmental Security. The course covers policy and technical and legal problems relevant to the environment and the military. There were 26 students enrolled in this first offering which is unique to NPS. Eight research projects are currently underway by the students and faculty ranging from toxic waste disposal to political instability caused by environmental problems.

The course and research are being team led by Senior Lecturer Rodney Minott (former Ambassador of Sweden) and Dr. James Armstead of the Department of National Security Affairs, and Professor Conrad Newberry of the Department of Aeronautics and Astronautics.

--continued from page 29

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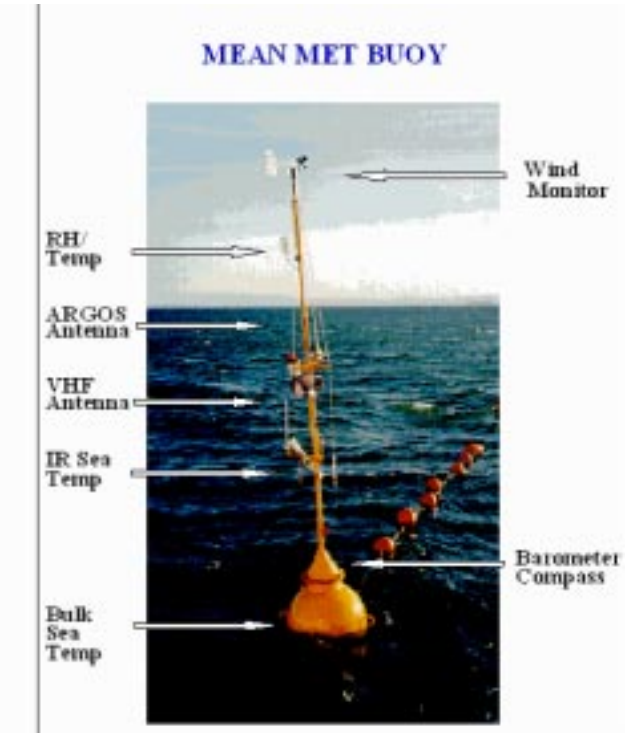
Professor Ken Davidson and staff persons of the Department of Meteorology deployed an instrumented buoy in Monterey Bay to provide atmospheric information for Department of Oceanography faculty investigations of shoreline remote sensing and ocean wave modeling. The deployment location is 5 + miles off Moss Landing, California, but this will change, most likely, when a second phase of the investigation begins in November. At least two phases are planned to have five months of near-continuous data.

The buoy (right) was featured in an earlier *NPS RESEARCH* on Department of Meteorology Laboratories (*RESEARCH*, Vol. 9, No. 1). Continuously measured on the buoy are 5-meter height values of average pressure, vector wind, temperature, humidity, and the fluxes of momentum and heat. Further, the buoy instrumentation also measures sea temperature with three different sensors and two dimensional waves. The buoy has been used in five different experiments the past two years in San Diego Bay and off the North Carolina Outer Banks. This last deployment is important because of the Monterey Bay location and collaboration with the NPS Department of Oceanography. The goal is to have two of the toroid buoys available within the next year. This deployment has the longest duration of all in the past, which included locations off Norway five years ago.

The current deployment is part of an NPS effort to monitor ocean features in Monterey Bay for answering both science questions and to develop measurement methods.



HELICOPTER WARNING SYSTEM, *continued from page 13*

moving map software on a kneeboard computer system. The VRS program allows the user to select a helicopter type and enter a base weight. The choice of a helicopter type automatically sets the rotor radius, used to calculate the hover induced velocity, and the information necessary to pull required data from whatever avionics configuration (MIL-STD 1553 or ARINC-429) exists on that type of helicopter. The base weight is the helicopter's weight including crew and equipment, but without fuel weight. The VRS program currently defaults to a CH-60 and a base weight of 18,000 pounds. If a base weight other than 18,000 pounds is desired the user simply clicks on the base weight display window to bring up a numeric keypad in order to make a different entry. "Clear" and "Enter" keys are also available on the keypad. Once 'ENT' has been selected the keypad will close and the entered weight will be displayed. Data monitored over an ARINC-429 data bus provides real time updates of the fuel weight for each tank used in the helicopter. Once the helicopter type and base weight have been set, the user may select 'RUN' for the application to begin. Figure 2 shows the VRS GUI during the process of updating the base weight.

When the 'RUN' button is activated, the VRS program computes a boundary based on the current atmospheric conditions and helicopter weight. This boundary is plotted on a graph on the VRS display. The helicopter's position in terms of airspeed and rate of descent is shown on the graph with a helicopter icon. Any value outside of the range of the graph is defaulted to the maximum value appearing on the graph. Thus, there is no confusion from what direction the helicopter is approaching the vortex-ring state boundary. The VRS display can be minimized allowing other applications to be used. Penetration of the vortex-ring state boundary causes the VRS display to maximize itself, covering all other applications. Simultaneously, the program begins flashing the background color surrounding the graph and issues an aural warning. The aural warning is recorded as a .wav file. For the demonstration it was played on speakers. In the aircraft it will be sent to the pilot over the intercom system. The program will not allow minimization of the main window while a penetration of the vortex-ring state boundary exists. Should the weight of the helicopter need to be updated, i.e., additional passengers, a 'STOP' button may be depressed in order to allow the base weight to be changed. The program may be minimized while not in a warning by selecting the 'HIDE' button or closed completely by depressing the 'QUIT' button.

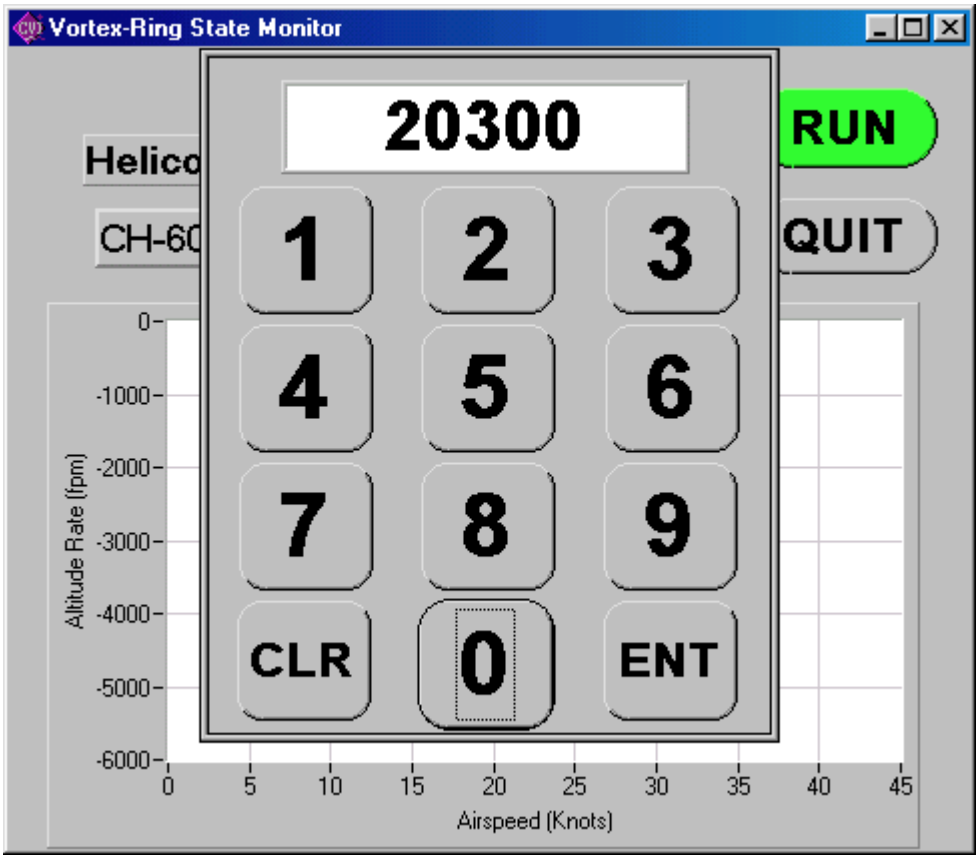


Figure 2. Entering base weight

Figures 3 through 6 illustrate the operation of the VRS program. Figure 3 shows the helicopter in level flight at a speed of 105 knots. The helicopter icon is shown partially off screen at the upper right-hand corner of the graph. The vortex-ring boundary is shown for standard atmospheric conditions and a base weight of 18,000 pounds. Figure 4 shows a similar display where the atmospheric conditions and helicopter weight have increased the required hover induced velocity. This results in a VRS boundary that is shifted down on the graph and

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HELICOPTER WARNING SYSTEM, *continued from page 32*

increased in size. Figure 5 shows a helicopter during a safe descent. Figure 6 shows a helicopter that has penetrated the VRS boundary causing a warning to be issued.

The algorithm selected for plotting the VRS boundary was chosen based on research performed by LCDR Varnes. The algorithm was chosen based on an analysis of three previous prediction algorithms and on comparisons with flight test data of an H-34 helicopter. Other work described in his thesis includes an analysis of the terminology associated with the vortex-ring state, a survey of relevant safety

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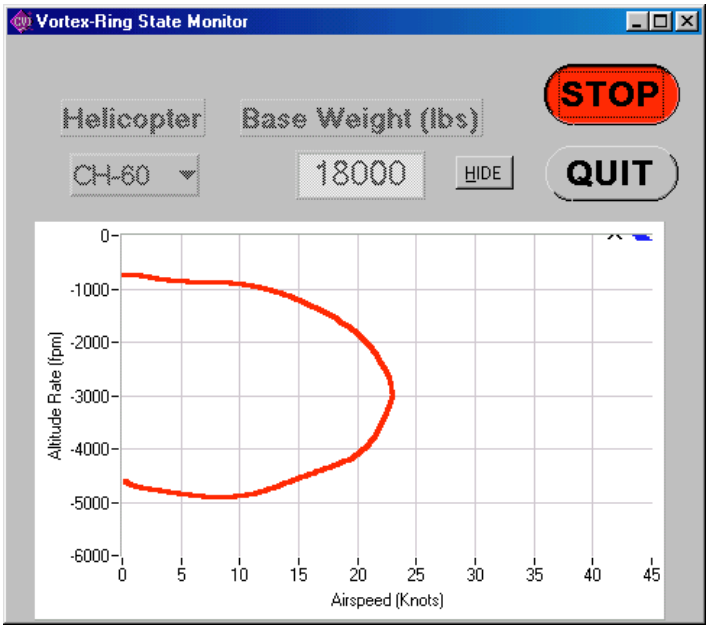
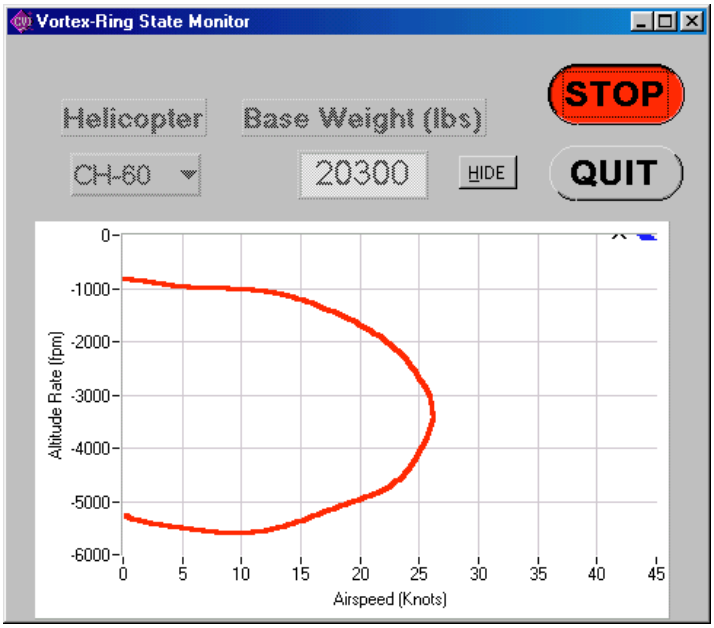
Figure 3. Level Flight on a Standard Day (top left)

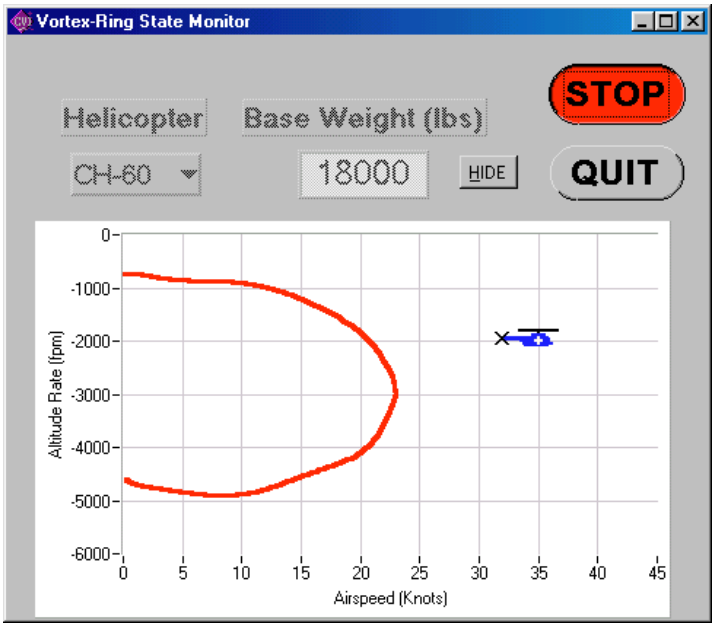
Figure 4. Level Flight, Hot and Heavy (top right)

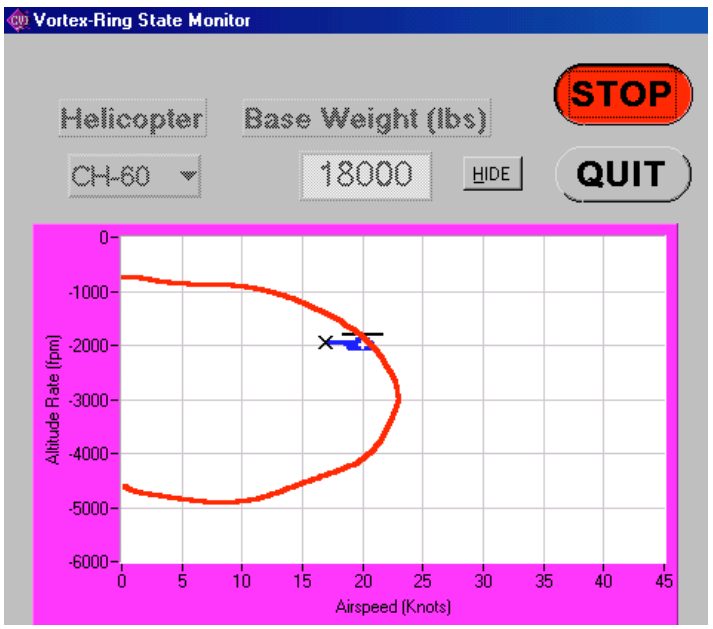
Figure 5. Performing a Safe Descent (lower left)

Figure 6. Maximized Display While Issuing a Warning (lower right)









HELICOPTER WARNING SYSTEM, *continued from page 33*

data, and a quick look at secondary indicators of the vortex-ring state.

The kneeboard computer system that hosts the VRS warning program was developed by the VH Systems Engineering IPT. It is connected to the aircraft's avionics data buses as a bus monitor or receiver. The installation requires no modification to existing avionics operational flight programs (OFPs). This allows new functions to be added quickly without disturbing existing systems. The next step in the development of the VRS Warning System will be to verify the operation of the complete system on an actual aircraft. This will be followed by flight testing to validate the boundary calculated by the prediction algorithm. Plans are being developed to accomplish flight testing in the near future.

The demonstration could not have been completed without the assistance of many people. The ONR Naval Science Assistance Program (NSAP) provided funding and support for the development. Mr. Herman Kolwey from Pax River suggested the vortex-ring state problem and provided continuos technical assistance. Members of the VH Systems Engineering IPT were of great assistance in co-developing the two demonstration programs and configuring the hardware for the demonstration. In particular the efforts of Mr. Carl Zaslow and Mr. Jim Tomasic were indispensable.

SENSITIVITY OF SUBMARINE HYPERSPECTRAL CONTRAST, *continued from page 12*

have sensors effective over the broad range of environments and threats we are likely to encounter, we are required to take an ensemble approach to sensor employment and find technologies that are effective over complementary environmental conditions. HSI is a good fit in this projected mix of sensor technologies for finding small, diesel electric submarines in littoral waters.

LT Jack Thomas was recently awarded the MORS/Tisdale Graduate Research Award. The Military Operations Research Society (MORS) sponsors the award for outstanding thesis work in the Naval Postgraduate School's Department of Operations Research.
The award recognizes high quality research of immediate or near-term value.

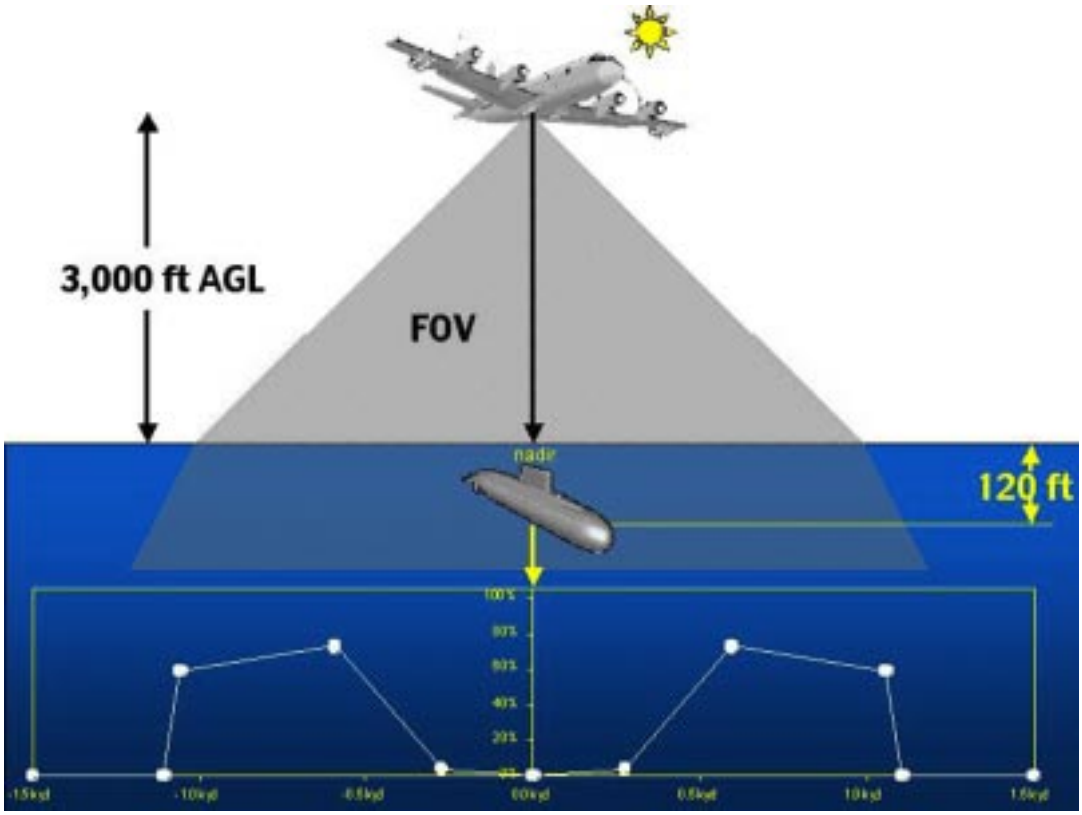


Figure 2. The high noon hole that arises when high sun altitude causes a large amount of nadir viewed glint. This phenomenon was hypothesized to be problematic prior to this research, but its exact impact was unknown. The plot is probability of detection versus lateral range. The area under this curve is the effective sweep width.

PUBLIC KEY INFRASTRUCTURE (PKI) INTEROPERABILITY: A SECURITY SERVICES APPROACH TO SUPPORT TRANSFER OF TRUST

LT Anthony P. Hansen, United States Navy
Master of Science in Systems Engineering-September 1999
Advisors: Associate Professor James Bret Michael and Associate Professor Timothy J. Shimeall, Department of Computer Science.

Public key infrastructure (PKI) technology is at a primitive stage characterized by deployment of PKIs that are engineered to support the provision of security services within individual enterprises, and are not able to support the vendor-neutral interoperability necessary for large, heterogeneous organizations such as the United States Federal Government. Current efforts to realize interoperability focus on technical compatibility between PKIs. This thesis defines interoperability as the capacity to support trust through retention of security services across PKI domains at a defined level of assurance and examines the elements of PKI interoperability using this more comprehensive approach.

The initial sections discuss the security services PKIs support, the cryptography PKIs employ, the certificate/key management functions PKIs perform, and the architectural elements PKIs require. This provides the framework necessary for discussing interoperability. Next, the two fundamental aspects of interoperability, technical and functional, were presented as well as their constituent elements and the existing barriers to interoperability. Finally, the proposed U.S. Department of Defense and Federal Government PKI architectures were analyzed and recommendations made to facilitate interoperability.

ROOM DE-REVERBERATION USING TIME-REVERSAL ACOUSTICS

LT David W. Liddy, United States Navy
Master of Science in Applied Physics-September 1999
LCDR John F. Holmes, United States Navy
Master of Science in Applied Physics-Sept. 1999
Advisors: Associate Professor Andrés Larraza and Assistant Profesor Bruce Denardo, Department of Physics

This thesis probes the performance of one–channel time–reversal acoustics in a chamber in terms of the geometry of the cavity. In particular, a rectangular chamber is compared to an enclosure that has a stadium shape. The mode structure in the rectangular cavity is highly symmetric, while it is highly irregular in the stadium-shaped cavity. Time-reversal acoustic techniques produce an improved focus in the latter. The focusing quality is determined as a function of frequency, time–reversal window size, and spatial extent. A scheme for encrypted acoustic communication, both in air and underwater, that uses multiple broadband signals with identical bandwidth, Hanning window source spectra, and center frequencies separated by half the bandwidth, allowing for null detection between adjacent signals, is successfully investigated.

TECHNOLOGY TRANSFER, *continued from page 24*

SURFACE MODIFICATION OF SYNTHETIC DIAMOND FOR PRODUCING ADHERENT THICK AND THIN FILM METALLIZATIONS FOR ELECTRONIC PACKAGING (U.S. Patent No. 5,853,888)

Inventors: Associate Professor Indranath Dutta and Research Associate Professor Sarath K. Menon, Department of Mechanical Engineering

An article and a method of making surface modified synthetic diamond substrates at temperatures below 500° C. for electronic packaging applications are described. The article consists of a synthetic diamond substrate, the surface of which has been modified by providing an adherent thin coating of a ceramic (alumina) material so as to enable metallization of synthetic diamond by current industrial methods. The method of surface modification comprises deposition of a thin transition metal layer on the synthetic diamond substrate prior to low temperature reactive vapor deposition of aluminum followed by annealing in an oxygen atmosphere.

WIRELESS NETWORKS ONBOARD SUBMARINES, *continued from page 3*

Figure 2 depicts the applet version interface of the client module that uses a series of buttons, text fields, and radio buttons to report casualty information. The interface was designed to be simple to use with a pen/stylus as the only input device. The client side module runs on a handheld or wearable computer. The crew member enters casualty information by depressing appropriate buttons. The entered information is wirelessly transmitted to the damage control command database after depressing "Submit Update" button. Similar prototype applications have been developed for watchstander log, maintenance management, supply inventory, and repair manual [1].

Figure 2. The Client Side Interface of the Damage Control Application

Shipboard Testing Results

The investigation of the above three research areas was conducted in the laboratory as well as onboard ships. An initial feasibility test was conducted onboard the *USS Ohio* (SSBN 726) in August 1997, followed by a test on the *USS Harry S. Truman* (CVN 75) in March 1999, and another test on the *USS Memphis* (SSN-691) in August 1999. Selected testing results are described below. Complete testing results are available from the theses listed in the references at the end of this article.

A prototype wireless local area network was assembled in early 1997. A series of tests were conducted in the laboratory environment prior to a shipboard test on the *USS Ohio* in August 1997. The primary objective of those tests was to evaluate the viability of WLANs on submarines. The wireless network chosen for evaluation was a Digital Ocean Grouper radio pack and its corresponding access point, the Starfish II. The radio pack was not in the form of a PCMCIA card. The handheld computer selected was an Apple Newton MessagePad 2000. These components represented the state of the art at the time. The Digital Ocean's wireless network was based on the Lucent Technologies 900 MHz DS/SS WaveLAN. The MessagePad 2000 led the way in handheld computers by providing the most powerful processor (DEC StrongARM 110 at 162MHz), the best handwriting recognition, and rugged design. Laboratory and shipboard testing yielded the average data throughput of the WLAN from 70.0 to 90.0 Kbps, depending on the distance between the access point and the handheld computer. The maximum indoor communication range was determined to be 30m. Shipboard tests concluded that ten access points would be needed to fully cover an Ohio Class submarine: three access points for the forward compartment, four access points for the missile compartment, and three more for the engine room. The Digital Ocean Grouper radio's transmit power of 250 mW exceeded the EMI requirements of MIL-STD-461C, and one EMI occurence was detected in the shipboard test [2].

Encouraged by the *USS Ohio* testing results and supported by the NSSN Program Office, more in-depth studies in the three areas listed above were followed. A wireless network composed of the latest IEEE 802.11 compliant components

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WIRELESS NETWORKS ONBOARD SUBMARINES, *continued from page 36*

was constructed in late 1998 and early 1999. Two shipboard tests were conducted, one in the hangar bay of the *USS Harry S. Truman* and another on the *USS Memphis*. Selected results from the Truman test are shown in Figures 3 and 4. Figure 3 depicts data throughput as a function of range and number of clients.

It is noted that throughput decreases as the distance from the client to the access point increases, and it also decreases as more clients transmit or receive data from the same access point. This suggests that it is not sufficient to cover the area of interest with the minimum number of access points. Consideration should also be made with respect to the number of potential users in a particular area. It is also noted that the highest throughput reached 1.4 Mbps, compared to 90 Kbps achieved in the Ohio test. Figure 4 illustrates date rates at various location of the hangar bay. The access point was placed on the starboard side just aft of the hangar bay window at Frame 120. It should be mentioned that one access point covers the entire hangar bay. But as noted earlier, data rates will drop as more users enter the same area. As a result, more than one access point may be needed to prevent data rates from dropping

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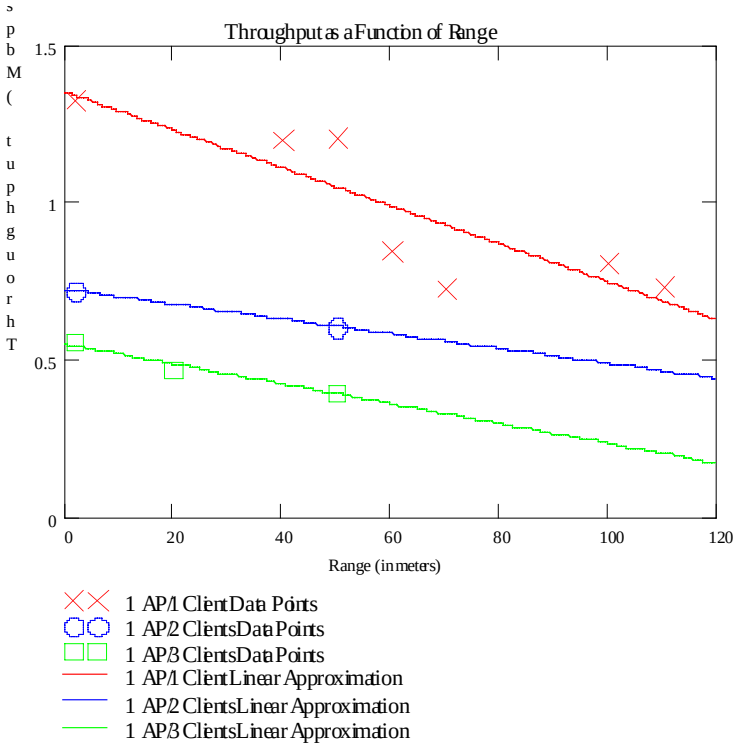

Figure 3. Throughput as a function of Range and Number of Clients

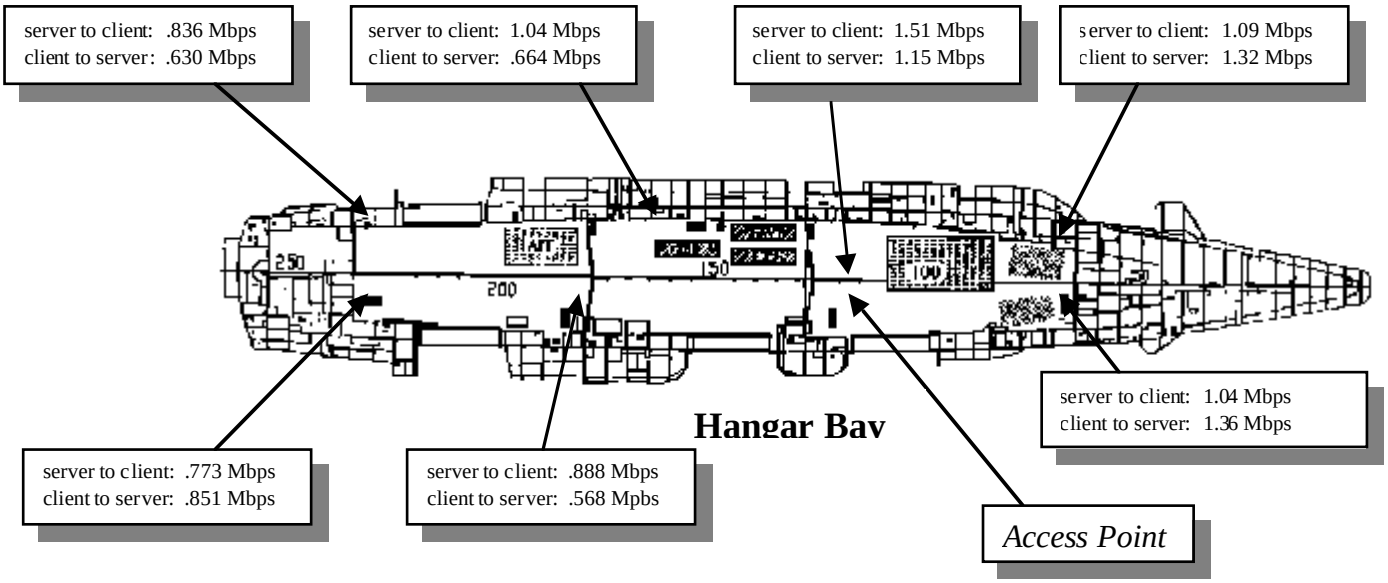

Figure 4. Throughput at Various Locations in the Hangar Bay of *USS Harry S. Truman.*

WIRELESS NETWORKS ONBOARD SUBMARINES, *continued from page 37*

below a certain level.

The first objective of the Memphis test was to determine the number and optimal locations of access points required to cover the Los Angeles Class submarines, and throughput between clients and access points. It was determined that ten access points are needed: four in the engine room and six in the forward compartment. These access points provided signal-to-noise ratios (SNR) from as high as 50 dB to 20 dB in virtually every corner of the submarine. A summary of data rate measurements is listed in Table 1. It is noted that the signal strength had no significant impact on data rate. Average data rates of 1.2 to 1.4 Mbps are achieved throughout the submarine with relatively small variations from one location to another [3].

SNR		>50dB	50-40 dB	40-30 dB
Forward Compartment	server to client	1.44	1.44	1.44
	client to server	1.25	1.26	1.23
Engine Room	server to client	1.42	1.40	1.40
	client to server	1.22	1.22	1.22
Total	server to client	1.43	1.42	1.42
	client to server	1.24	1.23	1.23

Table 1. Average Data Rates (in Mbps) from testing conducted onboard *USS Memphis*

The second objective was to evaluate the effectiveness of various wearable computers and handheld computers. It turned out that wearable computers (Xybernaut and ViA II) in their present form are not suitable for use in submarines. Hard disks carried on the waist belt may easily collide with the deck while climbing ladders or yielding to oncoming crew members in narrow passageways, causing them to crash. The third objective was to obtain crew feedback on the prototype software applications. Surveys conducted aboard indicated that the damage control and maintenance manager applications were desirable, the graphical interface was well understood at all levels of user experience, the boot cycle time required by Windows 95/98 devices was too long, and the

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DISTRIBUTED SOFTWARE APPLICATIONS IN JAVA FOR PORTABLE PROCESSORS OPERATING ON A WIRELESS LAN

LT Kurt J. Rothenhaus, United States Navy
Master of Science in Computer Science-September 1999
Advisor: Professor Ted Lewis, Department of Computer Science
Second Reader: Associate Professor Xiaoping Yun, Department of Electrical and Computer Engineering

As the wave of future information technology makes its way into the construction and design of new ships and submarines, it is imperative to examine methods to thoroughly and economically backfit older platforms with similar technology. Affordable, commercial-off-the-shelf (COTS) industrial products have provided us with a means to reduce miscommunication and exponentially increase the availability of information via small pen-based computers operating on a wireless LAN. To take full advantage of the communications capabilities of these units and to fill the unique needs of the afloat Navy, the development of software applications is required. These software applications must be effective, tailored, and inexpensive if they are to be made available to older platforms. A distributed JAVA-based Intranet is the solution. The simplicity and economy of web-based software coupled with the power and functionality of pen-based computers creates a dynamic and effectual architecture.

WIRELESS NETWORKS ONBOARD SUBMARINES, *continued from page 38*

instant on/off feature of Window CE devices was preferred.

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[3] Mark W. Roemhildt, "Analysis and Vulnerabilities of Spread Spectrum Wireless Local Area Networks on Surface and Sub-Surface Combatants," MS in Systems Engineering, Naval Postgraduate School, September 1999.

ANALYSIS AND VULNERABILITIES OF SPREAD SPECTRUM WIRELESS LOCAL AREA NETWORKS ON SURFACE AND SUB-SURFACE COMBATANTS

LT Mark W. Roemhildt, United States Navy
Master of Science in Systems Engineering-September 1999
Advisor: Associate Professor Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: Vicente Garcia, National Security Agency Cryptologic Chair Professor

This research effort discusses data transfer over Local Area Networks (LAN) that utilize a wireless transmission medium. The Wireless Local Area Network standard, IEEE 802.11, utilizes two major spreading schemes in the form of Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS) techniques. This thesis addresses and compares these two spreading schemes.

Naval vessels pose unique transmission difficulties due to the inherent multi-path environment within the skin of the ship as well as the security risks corresponding with the potentially hazardous area in which they must operate. Research was conducted in order to determine how effective and vulnerable an IEEE 802.11 compliant Wireless LAN (WLAN) network would be on a surface and sub-surface combatant.

WLANs also pose several vulnerability issues that may jeopardize the information being transmitted. This thesis addresses vulnerability and exploitability issues as well as security and encryption methodologies.

During a recent visit to NPS, Susan Bales, Director of the Naval Science Assistance Program, listened to a brief by Associate Professor Russ Duren, Department of Aeronautics and Astronautics, and LCDR David Varnes, USN, on their NSAP-funded project on the Development of a Helicopter Vortex-Ring State Warning System Through a Moving Map Display (see page 13).

FEATURED PROJECT

ORGANIZATIONAL FACTORS IN AVIATION ACCIDENTS, *continued from page 5*

Aviation Safety, senior aviators in operational commands, junior aviators from the Navy and Marine Corps, plus aviation safety and human factors specialists. Led by an operational flag officer, the initial lead taken by RADM Robert Nutwell, the Commander of Carrier Group Three, the QMB met bi-weekly through video teleconferencing. Early on, the QMB defined ten broad areas for intervention: leadership, organizational effectiveness, training and qualifications, standard operating procedures, policy, aircraft and aircrew systems, safety information management, mishap investigation, human factors evaluation, and operational risk management.

The research described below began as a means of providing the Human Factors QMB with feedback on issues concerning: command climate, morale of Naval personnel, workload and resource availability, success of ongoing safety interventions, and other factors related to safely managing Naval flight operations. The research evolved into the development and application of a methodology that will enable a command to assess its performance on key attributes of successful safety management, with the intention of providing early feedback to the command as an integral part of the mishap prevention process. Used in conjunction with other ongoing and planned safety interventions, the ultimate goal in the long run is to reduce the aircraft mishap rate.

Command Safety Assessment (CSA) Study

Under sponsorship of Mr. Richard Healing, U.S. Navy Undersecretary's Office of Safety and Survivability, a systematic study of organizational factors in aviation accidents was undertaken. The CSA began by focusing on key organizational issues in order to improve our understanding of the possible influence that a Naval command may have in the chain of events leading to an aircraft mishap. Organizational research conducted by Professor Karlene Roberts from the University of California-Berkeley Haas Business School, and her colleague, Dr. Carolyn Libuser from the University of California-Los Angeles, proved useful in the formulation of the early research framework and analysis. Roberts discussed key attributes of organizations that were successful in reducing risks associated with hazardous operations. She labeled such organizations as "high reliability" organizations. A high-reliability organization is one that operates in a hazardous environment, yet produces a very low rate of accidents and incidents. Dr. Roberts studied several kinds of organizations, and identified air traffic control, nuclear power plants, and U.S. Navy aircraft carriers as examples of organizations that performed as high reliability organizations. Libuser and Roberts believed that organizations, which operate safely and effectively, have certain key characteristics in common, such

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AUTOMATING THE AVIATION COMMAND SAFETY ASSESSMENT SURVEY AS AN ENTERPRISE INFORMATION SYSTEM (EIS)

CDR Fred J. Mingo and LT Jonathan S. Held, United States Navy
Master of Science in Computer Science-March 1999
Advisors: Associate Professor C. Thomas Wu, Department of Computer Science, and Professor Anthony P. Ciavarelli, School of Aviation Safety

The Aviation Command Safety Assessment (ACSA) is a questionnaire survey methodology developed to evaluate a Naval Aviation Command's safety climate, culture, and safety program effectiveness. This survey was a manual process first administered in the fall of 1996. The primary goal of this thesis is to design, develop, and test an Internet-based prototype model for administering this survey using new technologies that allow automated survey submission and analysis.

The result of this thesis is a web site [http://spitfire.avsafety.nps.navy.mil] that adheres to a three-tier client/server architecture. The back-end SQL server database used to store survey information is accessed via front-end Java applets or Hypertext Markup Language (HTML) forms. Middleware components that complete the connection between client and server include Weblogic's Fastforward JDBCTM driver and Java servlets. The ASCA web site utilizes many Internet technologies: Active Server Pages (ASP), HTML, Javascript, Active X, Secure Sockets Layer (SSL), CGI scripts, JDBCTM , and Java applets and servlets. This thesis leads the reader through the research and development process describing how each of these technologies is used. Thorough review of this material is necessary for lifecycle support and future project revisions.

FEATURED PROJECT

ORGANIZATIONAL FACTORS IN AVIATION ACCIDENTS, *continued from page 41*

as leadership style, sound safety management policies, procedure standardization, adequacy of resources and staffing, a defined system for risk management, and other factors.

In related research Zohar (1980) discussed various concepts of safety climate. Zohar considered safety climate to be a subset of overall organizational climate. Safety climate refers to the shared perception of an organization's members that the organization's leaders are genuinely committed to safety of operations, and have taken appropriate measures to communicate safety principles, and to ensure adherence to safety standards and procedures. An organization's safety culture is defined as the shared values, beliefs, assumptions, and norms which may govern organizational decision making, as well as individual and group attitudes about danger, safety, and the proper conduct of hazardous operations.

In his comprehensive review of organizational culture Schein (1990) indicated that researchers have studied "organizational climate" much longer and more extensively that organizational culture. Therefore organizational culture as a theoretical construct is not as well developed. Schein defines culture as, "a pattern of basic assumptions that are invented or discovered by an organization as it learns to cope with problems of external adaptation and internal integration. As a result of adaptation and organizational functioning, a system of shared beliefs, values, attitudes and norms emerge which govern individual and group behavior. Culture becomes the driving force and it provides the guiding principles behind an organization's goal structure, a means to attain goals, the source of criteria for measuring progress, and the origination of methods for correcting deviations from norms and expected outcomes. Culture is passed on to successive generations of an organization's members, and culture molds behavior of individuals through a system or rewards, expectations about status, power, authority, established group boundaries for inclusion or exclusion, and underlying concepts for managing deviations from norms. Culture is learned by individuals who join an organization and is strongly influenced by the organization's structure and leadership.

The principal factors that contribute to an organization's culture include operational criteria for personnel selection, formal training practices, explicit and implicit role expectations, and especially the actions of leaders as demonstrated by their example. An organization's culture is heavily influenced by what leaders pay attention to, and by what they express as the core values or expectations of personnel under their supervision.

While cultural factors are quite difficult to define in terms amenable to observation and measurement, the Model of Organizational Safety Effectiveness developed by Professor Tony Ciavarelli and LtCol Robert Figlock, USMC, incorporated into their measurement framework some organization climate and cultural aspects that may underlie Navy and Marine Corps values and norms of behavior. For example, Naval aviation officers have a tradition of a "can do" attitude and a reputation for completing missions assigned in spite of danger and adversity. Simply landing an aircraft at night, perhaps with the ship's deck pitching, may say enough about this aspect of their culture. Naval Aviators develop a high degree of peer loyalty and loyalty to their command. To some

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USABILITY EVALUATION OF THE AVIATION COMMAND SAFETY ASSESSMENT WEB-BASED QUESTIONNAIRE

LCDR Thomas G. Williams, United States Navy
Master of Science in Information Technology Management-June 1999
Advisors: Professor Anthony Ciavarelli, School of Aviation Safety, and Associate Professor Kishore Sengupta, Information Systems Academic Group

Computer software has taken an increasingly larger role in the U.S. Navy. It is used in nearly every facet of naval operations, from administrative chores to controlling complex weapons systems. Because of the high cost of software and the potential for inadvertent misuse, it is important that software be easy to use and understand. This thesis explores the methods and techniques available for conducting software usability evaluations. Using what is described in this thesis, actual software usability testing is done on a recently developed Web site. The Web site [http://spitfire.avsafety.nps.navy.mil] evaluated in this study is designed to allow aviation units to complete a safety survey online. This thesis describes the usability test conducted on the Aviation Command Safety Assessment (ACSA) Web site and establishes a methodology that can be used on any future Navy Web site. The results of this usability test show that improvement can be made to the interface design and presentation of Web site material.

ORGANIZATIONAL FACTORS IN AVIATION ACCIDENTS, *continued from page 41*

extent such peer loyalty may affect the willingness for some aviators to report observed safety violations. The commands themselves are given a substantial amount of autonomy. While modern communications, uniformity of fleet doctrine, and present command structure have mitigated the degree of autonomy over the years, there still remains a considerable latitude as to the day-to-day management and decision making at the unit level in our Naval Forces. Leaders in a particular command set the tone for a healthy command climate, and reinforcement of the safety culture. Differences in command climate and safety culture among commands may be a root source of certain unsafe attitudes and behaviors. Naval aviators themselves are characterized as strongly motivated and confident individuals that constantly strive to achieve excellence in their aviation and leadership skills. Such underlying cultural traits are thought to influence the attitudes and behavior of our aircrews in areas related to risk taking, competitiveness, the perception of danger, and certain decisions regarding safety of flight.

Model of Organizational Safety Effectiveness

A Model of Organizational Safety Effectiveness used to develop the measurement instrument, or organizational survey, was derived primarily from the works of Dr. Roberts and Dr Libuser who identified five major areas regarding the effectiveness of organizations in managing risk. The five areas, adapted for application to Naval aviators, are as follows:

- Process Auditing: A system of ongoing checks to identify hazards and correct safety problems.
- Reward System: The expected social rewards and disciplinary actions used to reinforce safe behavior, and correct unsafe behavior.
- Quality Control: The policies and procedures for promoting high quality work performance.
- Risk Management: A systematic process used to identify

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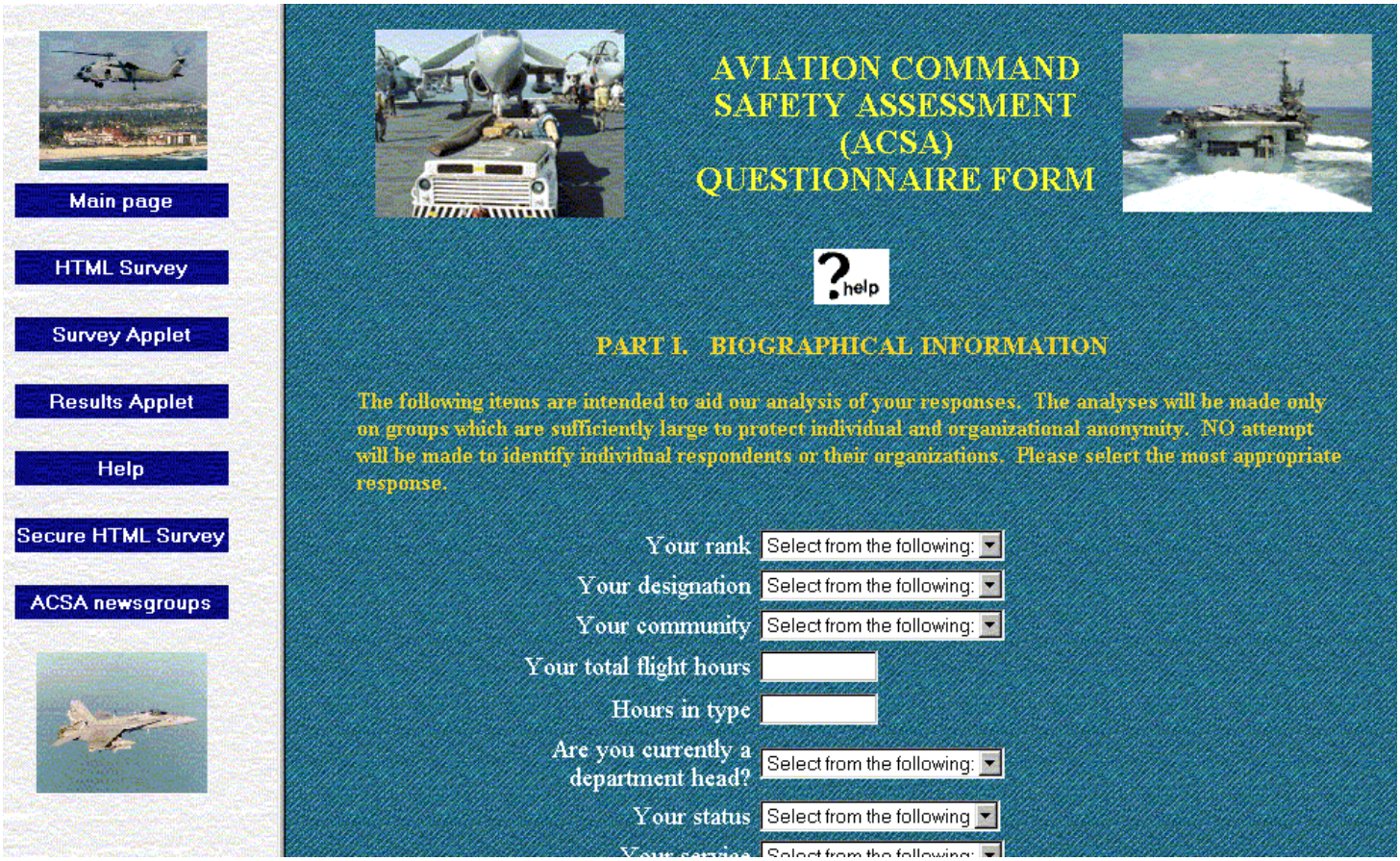


Figure 1. Internet based Aviation Command Safety Assessment Questionnaire

ORGANIZATIONAL FACTORS IN AVIATION ACCIDENTS, *continued from page 42*

hazards and control operational risk

· Command and Control: The organization's overall safety climate, leadership effectiveness, and the policies and procedures used in the management of flight operations and safety.

This model served as the basis for the initial Command Safety Assessment Survey questionnaire. The 57-item questionnaire was administered by mail to 69 Naval squadrons. A total of 67 units (97%) responded with a total of 1254 respondents completing the survey questionnaire. This sample was randomly selected from a sample frame which represented a proportional cross-section of both Navy and Marine aviation units from different Naval force categories, such as operational units, reserve and training squadrons, that represented a variety of aircraft types. The sample of respondents included only flight qualified Naval aviators, from the commissioned officer ranks, and not non-commissioned officers and enlisted personnel.

Data were analyzed descriptively for all categories of the model, and for all questionnaire items. Findings show that ratings for most items, particularly those items related to command climate, qualification standards, safety training, and leadership issues, were highly favorable. Ninety percent or more of the respondents gave favorable ratings on these specific items. Key findings of the survey revealed a general concern about operational tempo, workload, staffing, and resource availability. For example, 55% of the Navy respondents indicated that their commands were over-committed with respect to tasking and available resources, and 65% of the Marine Corps indicated that their commands were over-committed. Other areas of concern included a perceived need to improve certain safety interventions such as the use of Human Factors Boards to better manage the high-risk aviator, and the need to correct possible shortcomings of Aircrew Coordination Training (ACT). While responses to questions related to command climate and related command issues were mostly favorable, there were some areas warranting further evaluation, i.e., safety issues, social rewards for safe behavior, willingness to report violations, cutting corners to get a job done, adherence to crew rest standards, the desirability of serving in the Aviation Safety Officer (ASO) billet, and the adequacy of internal and external command communications.

Aviation Command Safety Assessment Questionnaire

The initial survey conducted served as a starting point for the development of an Internet based application for use Fleet-wide (see Figure 1, left). A revised questionnaire based on statistical validation tests and ease of use criteria was developed as well as preparation of administration and analysis guidelines for Fleet-wide application. The Command Safety Assessment web-based version is now completing final test and evaluation, and will be available to all Fleet squadrons in 2000.

CDR Fred Mingo, USN, and LT Jonathan Held, USN, developed the CSA operational software and web-based system. LCDR Thomas G. Williams, USN, conducted Fleet usability testing, and human interface design review and analysis.

Quantitative Analysis of Organizational Factors in Aviation Safety

Currently, the data collected is being analyzed using multivariate techniques. The quantitative analyses will yield two key benefits. First, the results will provide insights into the causal and associative relationships that impinge on safety in aviation organizations. Second, the analyses will enable researchers to take the next step in questionnaire development: calibrate the safety assessment instrument more closely toward the focus of an aviation organization.

Development of a Microworld for Assessing Safety in Organizations

Creating a microworld for aviation organizations is in the initial stage of development. Microworlds are computer-based simulations of the essential features of a complex domain of interest. Microworlds enable organizational decision-makers to attain insights into the dynamic and inter-temporal aspects of causal relationships that characterize environments such as aviation organizations. The availability of a high-fidelity microworld will enable managers to assess the feasibility of organizational policies and decisions with respect to their implications for safety.

Fleet Operational Application

CAPT Rod Casey, USN, Director of the School of Aviation Safety, is currently leading an effort to use the CSA to help the U.S. Marine Corps improve their safety programs. According to CAPT Casey, "The value of the CSA in supporting Fleet safety is that it provides a unit commander with feedback regarding safety climate before any serious problems occur."

THE TOTAL SHIP SYSTEMS, *contined from page 7*

understanding and controlling ship survival under conditions of progressive flooding is in process under Professors Calvano and Papoulias. LT Timothy C. Spicer, USN, a September 1999 graduate, has completed a thesis which examined some of the transient and steady state characteristics of progressive flooding; LT Tom Anderson, USN, a March 1999 graduate, initiated development of a design tool using a commercially available fluid systems simulation program. LT David Ruley, USN, and ENS Keith Kulow, USN, are beginning theses which will advance LT Anderson's work. Future teaming with the NAVSEA total ship survivability engineering community is expected to begin in Fiscal Year 2000.

Students work on ship design projects as a part of their TSSE coursework.

Figure 2. Maritime Preposition Ship 2010 for Center for Naval Analyses/United States Marine Corps.

In summary, TSSE has added to the rich variety of Navy-relevant work being done at NPS by providing a program where the entire ship is the subject of interest and where the process of turning mission-based requirements into conceptual designs can be experienced by students. The performance of this process in a team-oriented, interdisciplinary way provides officer students a valuable introduction into the process they will find themselves a part of in developing future defense systems.

SENSITIVITY ANALYSIS OF TRANSIENT AND STEADY STATE CHARACTERISTICS OF SURFACE SHIP PROGRESSIVE FLOODING

LT Timothy C. Spicer, United States Navy
Master of Science in Mechanical Engineering -Sept. 1999
Advisor: Associate Professor Fotis A. Popoulias, Department of Mechanical Engineering

The Navy's primary analysis of damage control and stability to date has been under static conditions. Dynamic effects, such as progressive flooding, and the dynamic damage control procedures, such as hole patching and dewatering, have not been included in present design requirements. The goal of this thesis is to develop and test a stand-alone progressive flooding model. This model can be used to evaluate the transient and steady state characteristics of shipboard progressive flooding. Several improvements over previous studies are introduced and their affects are assessed. A sensitivity analysis study is performed through a systematic series of runs for a variety of hull forms. These results can be used to aid engineers of future ship designs in the use of damage control techniques and parameters.

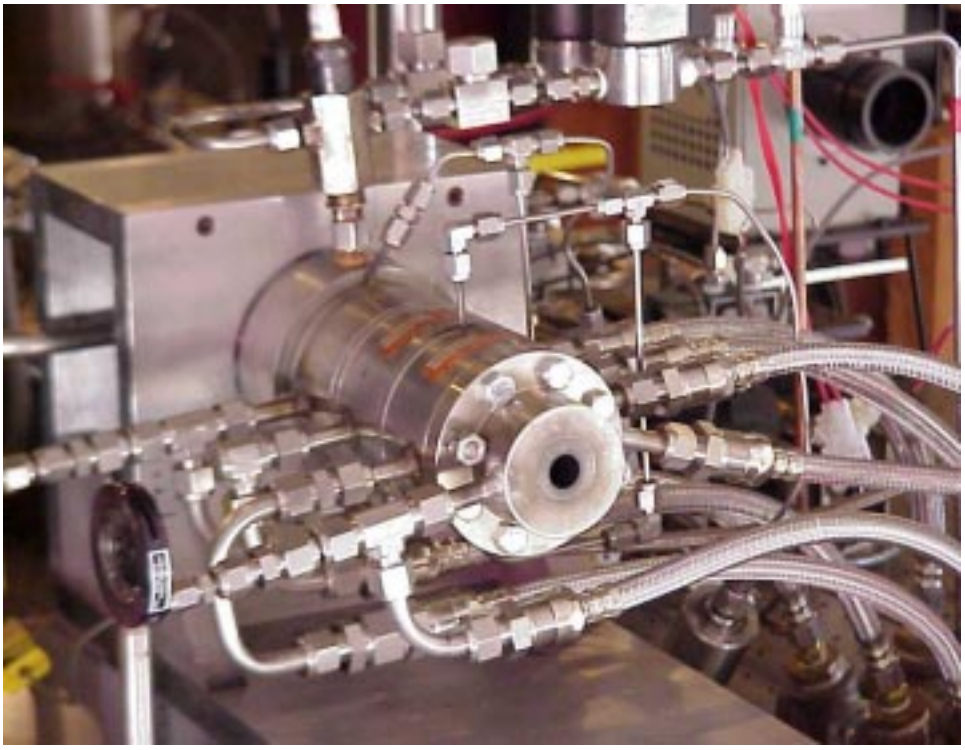
DEVELOPMENT OF A SIMSHART BASED PROGRESSIVE FLOODING DESIGN TOOL

LT Thomas J. Anderson, United States Navy
Master of Science in Mechanical Engineering-March 1999
Advisors: Professor Charles N. Calvano and Associate Professor Fotis Papoulias, Department of Mechanical Engineering

While the Navy addresses the effects of progressive flooding in its design requirements, its limits for damaged stability are the results of World War II damage analysis and are evaluated under static conditions, without regard for shipboard damage control systems. This thesis develops a program which utilizes the SIMSMART flow analysis program in tandem with naval architecture analysis in Microsoft Excel, to simulate progressive flooding of a ship based on the varying specifics of a given scenario. This program can be used to aid designers in dynamic simulation of the flooding process not only to determine the adequacy of de-watering equipment, but also to establish a timeline, including naval architecture parameters, throughout the process.

PROPULSION AND COMBUSTION LAB, *continued from page 9*

diagnostic technique involving the transmission of multiple wavelengths of visible and near IR light through the plume to experimentally determine the amount of soot present and the optical properties it possesses. The results are then fed back to modelers who then use the information to improve the performance and the accuracy of the modeling codes to predict the overall signature on a particular engine system.



Critical Issues for Pulse Detonation Engine Development

A new area of research in the propulsion field relates to the use of a detonation wave for propulsion. This type of engine operates in a cyclic manner where it loads a fuel/oxidizer mixture and detonates it repeatedly. The post detonation pressure "pushes" on the head wall of the combustor and results in thrust. Generally, the higher the operational frequency, the greater the average thrust observed. Although previous work at the laboratory have utilized gaseous fuels, recent efforts at RPCL have focused on the use of liquid fuels in such a system and have resulted in the first successful use of ambient

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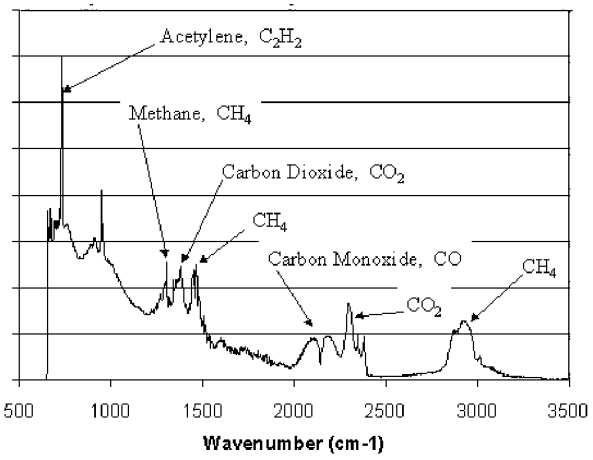
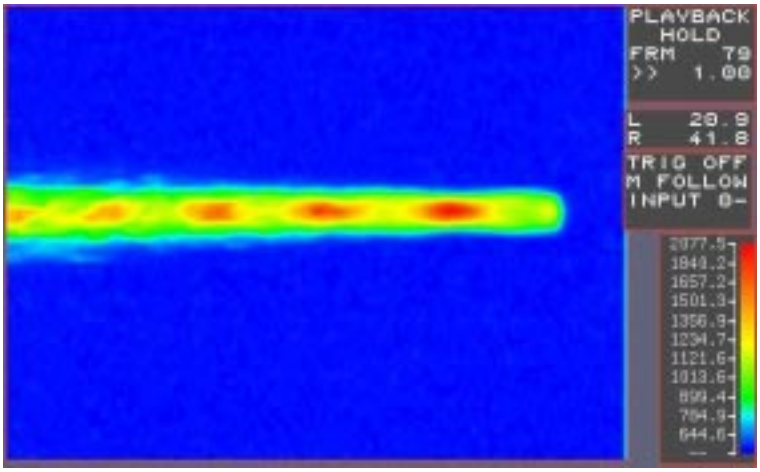
Above: Labscale Liquid-Fuel Rocket Engine

Below Right: Infrared Image of Rocket Plume

Below Left: Chemical species which contribute to a typical Plume IR Signature (obtained with IR spectrometer from AFRL)





PROPULSION AND COMBUSTION LAB, *continued from page 45*

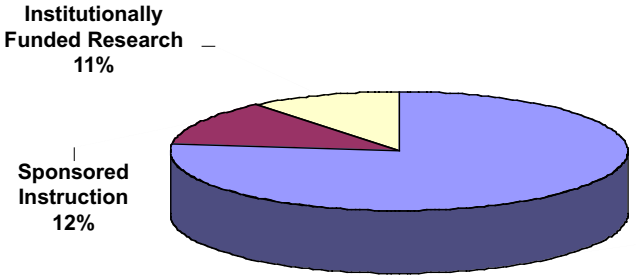
temperature JP-10 in such a system. LT John Robinson, USN, plans to further investigate the initiation of detonation in hydrocarbon fuels and air. His thesis will focus on the required ignition energy and configuration which results in the most favorable initiation strategy.

Thesis work being performed by LT Todd Hofstedt, USN, involves characterizing JP-10/a ir detonations and how non-uniform the fuel distribution in the main combustor may be while maintaining a propagating detonation wave. He will use optical diagnostic measurements along the combustor axis to simultaneously map the fuel distribution, heat release region, and shock wave structure. This will quantify the direct effect of fuel distribution on detonation wave structure and propagation through non-uniform conditions. LT Robert Johnson, USN, will utilize progress made by LT Robinson and LT Hofstedt on a new valveless PDE concept. This design eliminates the need for large air valves and will generally allow much higher operating frequencies. The potential gains are increased average thrust levels, a simpler geometry, and reduced fuel atomization requirements. This work will focus on investigating the engine at supersonic operating conditions, closer to what is expected for such a propulsion system.

Liquid Fueled Pulse Detonation Engine

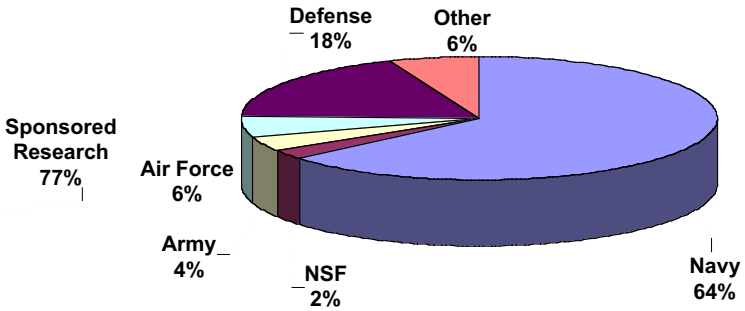
Due to the diminishing number of experimental propulsion research laboratories, the size and scale of RPCL provides a cost-effective resource for fundamental research and experimental validation for government agencies and commercial companies. The laboratory's ability to handle classified and proprietary information only increases the value of RPCL. By providing students access to advanced diagnostic equipment and propulsion hardware, RPCL supports the educational mission of NPS and continues to be an invaluable asset to the Navy and DoD.

NAVAL POSTGRADUATE SCHOOL
FY 1999 RESEARCH AND SPONSORED PROGRAMS



Total: $39 million

Figure 1. NPS research and other sponsored programs.



Total: $34.8 million

Figure 2. Sponsorship of NPS' externally funded research and instructional programs.

CONFERENCE CALENDAR

UPCOMING CONFERENCES AT THE NAVAL POSTGRADUATE SCHOOL

Date	Title	Sponsor
30 Sep-2 Oct 99	Paleo-Circulation Modeling of the Pan-Arctic Region Workshop (UNCLAS)	National Science Foundation
9-10 Nov 99	Application of Mathematical Signal Processing Techniques to Mission Systems (UNCLAS)	Naval Air Warfare Center-Weapons Division
30 Nov-2 Dec 99	Operational Users Group of the Joint Technical Coordinating Group (SECRET/NOFORN)	Naval Strike Warfare Center
18-21 Jan 00	American Institute for Aeronautics and Astronautics (AIAA) Strategic and Tactical Missile Systems Conference (SECRET/NOFORN)	AIAA
24-28 Jan 00	Accelerated Strategic Computing Initiative Principal Investigators Meeting (SECRET)	Lawrence Livermore National Laboratory
14-19 Feb 00	Tenth Defense Advanced Research Projects Agency (DARPA) Symposium on Photonics Systems for Antenna Applications (PSAA-10)(UNCLAS)	DARPA
8-18 Mar 00	Fourth International Technology and the Mine Problem Symposium (SECRET)	NPS
20-24 Mar 00	Sixteenth Annual Review of Progress in Applied Computational Electro-Magnetics (UNCLAS)	NPS/Applied Computational Electro-Magnetics Society (ACES)
27-30 Mar 00	Eleventh Annual U.S. Army Tank-Automotive and Armaments Command (TACOM) Ground Vehicle Survivability Symposium (SECRET)	American Defense Preparedness Association/ TACOM
24-28 Apr 00	Technology Review and Update Short Course	NPS
1-4 May 00	Forty-fifth Annual Joint Electronic Warfare Conference (SECRET)	Naval Air Warfare Center
23-24 Jun 00	Thirty-Fifth Annual Colonel Allyn D. Burke Memorial Dental Symposium (UNCLAS)	U.S. Army
15-18 Aug 00	Second International Hypersonic Waverider Symposium (UNCLAS)	National Aeronautics and Space Administration (NASA)/AIAA
7-9 Nov 00	American Institute for Aeronautics and Astronautics (AIAA) 2000 Missile Sciences Conference (SECRET)	AIAA
19-23 Mar 01	Seventh Annual Review of Progress in Applied Computational Electro-Magnetics (UNCLAS)	NPS/ACES

For more information, contact the NPS Conference Coordinator, Elaine Christian, at 831-656-2426 or by e-mail, echristian@nps.navy.mil.

RESEARCH DIRECTORIES

RESEARCH OFFICE

Associate Provost and
Dean of Research
David W. Netzer Code: 09
Phone: 831-656-3241
Mail: dnetzer@nps.navy.mil

Director of Research Administration and
Editor, *NPS RESEARCH*
Danielle Kuska Code: 91
Phone: 831-656-2099
Mail: dkuska@nps.navy.mil
research@nps.navy.mil

Research Programs
Judy Joyce Code: 91JJ
Phone: 831-656-5041
Mail: jjoyce@nps.navy.mil

Administrative Support Assistant
Dolores Jackson Code: 91DJ
Phone: 831-656-2098
Mail: djackson@nps.navy.mil

Conference Coordinator
Elaine Christian Code: 92
Phone: 831-656-2426
Mail: echristian@nps.navy.mil

Research Publications
Alice Roberson Code: 91AR
Phone: 831-656-2272
Mail: aroberson@nps.navy.mil

Research Support Services
Teri Jay Code: 91TJ
Phone: 831-656-1044
Mail: tjay@nps.navy.mil

Research Financial Analyst
(Reimbursable Programs)
Laura Ann Small Code: 91LS
Phone: 831-656-2271
Mail: lsmall@nps.navy.mil

Research Administration Assistant
(Institutionally Funded Research, Page
Charges, Technical Reports)
Nenita Maniego Code: 91NM
Phone: 831-656-2273
Mail: nmaniego@nps.navy.mil

Thesis Processor
Sandra Day Code: 91SD
Phone: 831-656-2762
Mail: sday@nps.navy.mil

Assistant Thesis Processor
Marietta Henry Code: 91MH
Phone: 831-656-3050
Mail: mhenry@nps.navy.mil

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